[ESTABLISHED 1832]
THE OLDEST RAILROAD JOURNAL IN THE WORLD

AMERICAN ENGINEER AND RAILROAD JOURNAL.

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R. M. VAN ARSDALE, INC.
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J. S. BONSALL, Vice-President and General Manager
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MARCH, 1911

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BOILER INSPECTION LAW

In view of the provisions in the previous bills proposed, there are many features in connection with the new Federal locomotive boiler inspection law that will be viewed with satisfaction by the motive power departments. For one thing it permits any road to have uniform boiler inspection throughout its lines instead of being subjected to as many different rules and requirements as there are States traversed. Again, it permits a flexibility of required inspections so that they can be suited to the conditions in various parts of the country, and in the third place it places the responsibility of inspection upon the railroad itself and not upon a government inspector. The government inspectors are, however, given ample authority to protect every decision and will be by no means mere figureheads, but on the other hand the railroads are well protected from unjust action.

It is required that each railroad shall file its boiler inspection rules for approval with the Commission and that upon such approval these rules shall become obigatory on each carrier. It is, of course, understood that the rules as approved are in the form of minimum requirements and that each company can make them more stringent if it desires. It would, therefore, seem advisable to have a united action of all companies for the purpose of adopting certain rules for boiler inspection, which would act as minimum requirements for all and could be easily adapted to the special conditions in each case. A movement with this in view has already been taken by the Master Mechanics' Association. The committee on boilers has already prepared a proposed set of rules for boiler inspection, that are universally applicable as minimum requirements. It is strongly urged that the different roads adopt these rules on that basis and submit them for approval to the Interstate Commerce Commission, as required by this law. These rules are in such form as to be suited, without alteration, to a great majority of the railroads and to those few which require greater care and more frequent inspection they can be easily altered to suit. If uniformity in this matter can be brought about by these means it will not only be of great assistance to the Interstate Commerce Commission in rendering decisions and orders after the law has been in operation, and appeals are presented to it, but in many cases it will mean that injustice and hardship to the railroads will be avoided.

GROUPING OF SHOPS IN ONE BUILDING

The placing of all the shops of a locomotive repair plant in one large building, as has been done at the Brewster shops of the Wheeling & Lake Erie, has advantages, particularly in a small shop where the erecting and machine shop cranes are not used to their full capacity and can satisfactorily serve the blacksmith and boiler shops as well, but from an operating standpoint it is probable that few shop superintendents will advocate this arrangement. It is the blacksmith shop that is the source of greatest annoyance, and even though down-draft furnaces and the greatest refinements in blowers, exhausters, etc., are employed, it is impossible to prevent the obnoxious gases and smoke from escaping and diffusing throughout the whole building. An atmosphere thus polluted is not only disagreeable and unhealthy, but also tends to corrode the bright work on machines and tools and to reduce the value of the excellent natural lighting now generally provided in machine shops. The boiler shop is not as bad an offender and very often the convenience of common crane service with the erecting shop more often offsets the objectionable smoke and noise, especially at points where heavy boiler work is comparatively infrequent. While there is no particular objection to doing the tender work in the same building with the erecting and machine shop it would seem better to have it performed in a separate structure located near the entrance track to the shop.

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Of course, on this subject it is foolish to attempt to lay down any set rules to govern all cases and these features can be de-

termined only after a thorough understanding of the local conditions. In spite of this, however, it would seem advisable, irrespective of the size of the plant, to locate the blacksmith shop in particular in a separate structure from the other shops, or at least to separate it off with partitions, and also, if possible, to have the boiler shop by itself.

HEAT TREATMENT OF ALLOY STEELS

In connection with the interesting and very valuable paper by Henry Southers on Alloy Steels for Railroad Use, which appears elsewhere in this issue, there is much food for thought on the general question of the application and treatment of this material, and it is doubtful indeed if any previous contribution on the subject has dealt with it so comprehensively within the somewhat narrow confines to which the author has limited his analysis in this instance.

The importance of the consideration as applied to locomotives can scarcely be overestimated. As pointed out by Mr. Southers, through the entire gamut of driving axles, tires, connecting rods, crank pins, piston rods, frames, springs and wheels, no single item can fail to be benefited in increased strength and toughness by heat treatment properly applied. A heat treated steel is a closer knitted steel; there are fewer cleavage planes, and less chance of progressive fissures and rupture, qualities which are much sought after by all users of metals carrying live loads. The impression is entertained by many that if a high priced alloy steel be purchased, and used as purchased, that full value is thereby obtained. The author of the paper, however, points out this belief as erroneous, in view of the fact that there is no alloy steel that will yield anywhere near the benefit that will compensate for the increased cost, unless it receives intelligent heat treatment at some stage of its adaptation for use, and that an alloy steel in a natural condition is but little better than a good plain carbon steel.

In his advocacy for the alloy steels in locomotive parts Mr. Southers deals with the subject at some length and in a manner most convincing. That portion in particular where the driving tires are taken under consideration presents a remarkably sound and strong argument in favor of this material, and the same reasoning is followed with equal consistency through the remaining locomotive details. Throughout the views presented the fact is made clear that the universal use of alloy steel is not advocated in this construction, and in fact is not necessary where the design of the parts becomes of such generous proportions that the full factor of safety is assured.

The paper bears the impress of careful study and preparation and, needless to add, of absolute familiarity with the subject. It will without a doubt stimulate new thought on a subject which has not received its full measure of consideration, and possibly from unfamiliarity with many features in connection therewith on which this interesting paper now throws much additional light.

ABUSE OF PLATE IN BOILER SHOPS

There was a very exhaustive discussion several years ago about the danger of flanging or working on steel when it was at the brittle temperature, and so much was said and written on the subject at the time, together with the notice taken by the Railway Master Mechanics' Association, that it was supposed all railroad boilermakers had stopped the practice. Repeated observations since that time, however, convince us that foreman boilermakers are not even aware that there is any particular danger in working steel at its brittle temperature, or even that there exists a brittle temperature.

While it is not expected that working boilermakers should know the science of their business, the foreman certainly ought to know that hammering a sheet when it is at a brittle temperature is sure to produce bad effects and ought not to be permitted. This also recalls the fact that hand flanging of boiler sheets is not by any means obsolete. More than one road now prominently in mind is absolutely devoid of a flanging press, and doing practically all of its heavy boiler repair work without outside assistance. There is not much room for dispute in the assertion that when this work is done in a hydraulic press the operations are so quickly performed that the sheet is in no danger of falling below the proper temperature. If a railroad company cannot afford to purchase a suitable press, those in charge should have their flanging done in a shop equipped with modern boiler making appliances.

It at times occurs to us that master mechanics and general foremen might watch the rough practices of the boiler shop to rather more advantage than they do. One of the immediate resultant effects would be a decreased number of boilers with cracked sheets. The fact is, however, that the demand for hurried output of work is responsible for a great deal of the inferior boiler making practices which cause so much trouble and annoyance to the men handling and caring for locomotives.

FOREIGN SUPERHEATER INVENTORS ACTIVE

The superheat question in foreign countries is at present in the throes of a most extraordinary development, one which, to say the least, is not devoid of certain features almost akin to absurdities. Innumerable patents have been granted and applied for, and some of these designs represent the acme of what may be safely called, from a practical standpoint at least, freakish ingenuity. That they are ingenius must be conceded, and also that they might serve the purpose for which intended, but their complication is such that the actual construction would prove a serious problem, to say nothing of inaccessibility so far as regards maintenance.

Although the majority of these weird devices will never outlive the paper stage, there is still no doubt but that a few of them at least will attain to an actual existence on a locomotive. The management of railways on the continent of Europe are courageous experimenters, which fact is well borne out by a review of the varied boilers, cylinder arrangements and valve gears which are now being so extensively tried out. They will take hold of the superheater with even greater avidity, as it is recognized in Europe as in this country as one of the liveliest subjects in the locomotive world.

Experimenting as conducted abroad is on a most elaborate scale. If a device survives the exhaustive tests which are invariably accorded it, and becomes incorporated into the practice of the road conducting them, then it can be safely credited with the possession of unquestioned merit. Should it, on the other hand, fail, it is equally safe to assert that it will never be heard of again from the same quarter. Along this line the suggestion may be to the point that it would be well for American motive power management at large to keep in closer touch with what is going on abroad than has been their practice heretofore. It may not be that anything will be learned thereby, but much at least can certainly be saved through taking advantage of these foreign experiments.

We regard the present superheat test on the London and North Western Railway as one of the most important which have been run anywhere in recent years. A superheat and a non-superheat engine of equal dimensions were constructed especially for these experiments, and the results therefrom will determine the question of superheat as a principle, so far as that railroad is concerned. Furthermore the data will be so complete that it must be conclusive, and whether influential or not, it must prove of unusual interest to users of locomotives all over the world. In this instance the superheater is quite similar to the Schmidt, which has achieved such decidedly good results in this country and on the continent of Europe, but in reviewing the North Western results it would be well not to neglect the freaks also. There will be enough of them in use abroad before long to create instructive entertainment, to say the least, even if endorsement is not compelling.

2-6-6-2 Type Locomotives with Articulated Boiler

ATCHISON, TOPEKA & SANTA FE RAILWAY.

AMONG 40 MALLET LOCOMOTIVES RECENTLY COMPLETED BY THE BALDWIN LOCOMOTIVE WORKS FOR THE ATCHISON, TOPEKA & SANTA FE RAILWAY TWO WERE FITTED WITH FLEXIBLE OR ARTICULATED BOILERS, ONE HAVING THE BALL AND SOCKET JOINT AND THE OTHER A BELLOWS TYPE OF CONNECTION.*

In 1909 the Santa Fe received from the Baldwin Locomotive Works four Mallet compound locomotives; two of these were of the 4-4-6-2 type with 73-in. drivers and were intended for passenger service.† The other two were of the 2-8-8-2 type with 63-in. drivers for the heaviest class of freight service.† Experience with these locomotives, together with the service of nearly 150 fast freight engines of the 2-6-2 type, which have been in use since 1902, has led that company to place an order with the Baldwin Locomotive Works for 40 Mallet locomotives of the 2-6-6-2 type. At its own shops in Topeka the company combined two of the Prairie type freight engines into a Mallet for experimental purposes and is now engaged in converting 14 of the same type into Mallets by the addition of complete new front units.

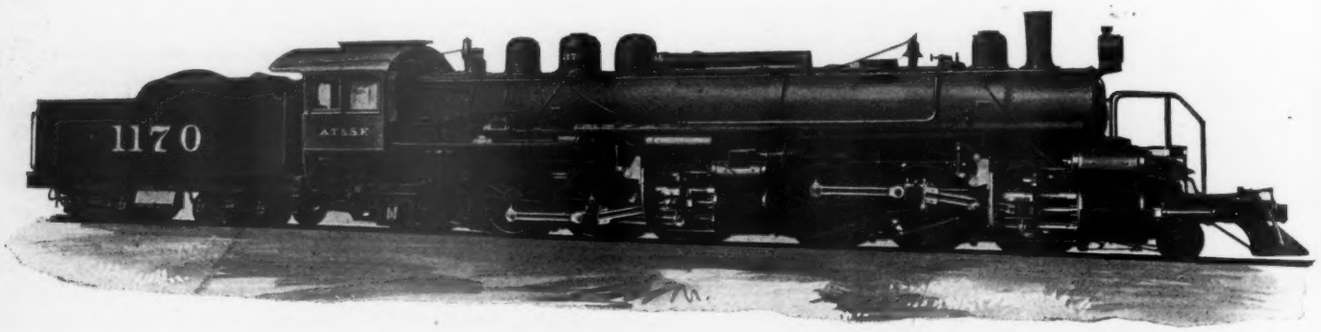
Of the 40 from the Baldwin Locomotive Works two are provided with flexible boilers—each having a different arrangement at this point, one being on the ball joint principle and the other with a bellows arrangement. With the exception of the arrangement of the superheater and reheater and the necessary changes in the steam pipes, these locomotives are the same as those with the rigid separable boiler. The engines have 24 and 38 by 28-in. cylinders, 69-in. drivers, carry 220 lbs. of steam and are fitted for burning coal. The theoretical tractive effort is 61,500 lbs. working compound. They all have the Jacobs-Schupert firebox and Buck-Jacobs superheaters and reheaters.‡

The 38 locomotives with rigid boilers have two steam domes on the evaporative section of the boiler, in addition to an auxiliary dome for safety valves and whistles. Twenty-eight of the locomotives have a straight type of boiler and 10 of the

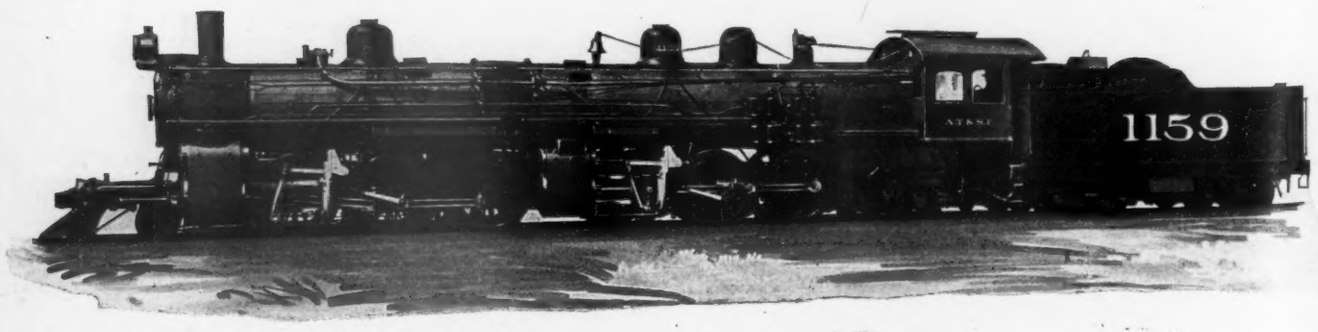
* Record No. 69 recently issued by the Baldwin Locomotive Works is given up to a description of these designs.

† See AMERICAN ENGINEER, Dec., 1909, page 475.

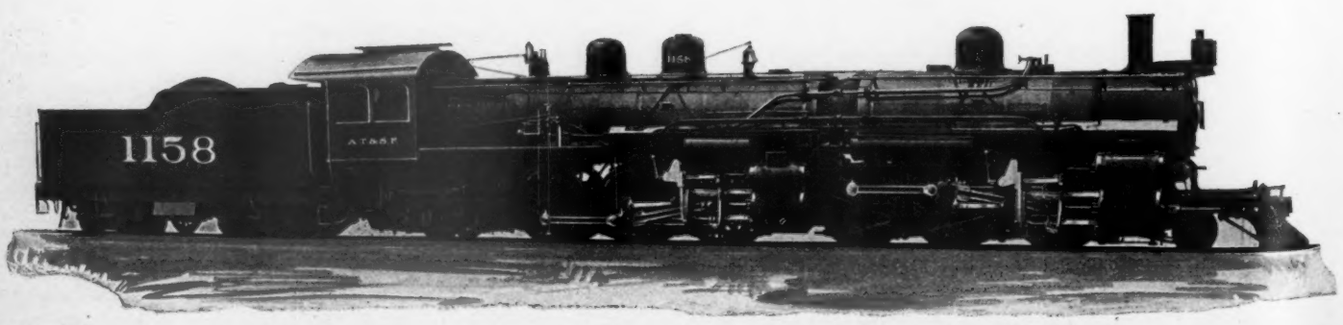
‡ See AMERICAN ENGINEER, Mar., 1909, page 106; Dec., 1909, page 480.



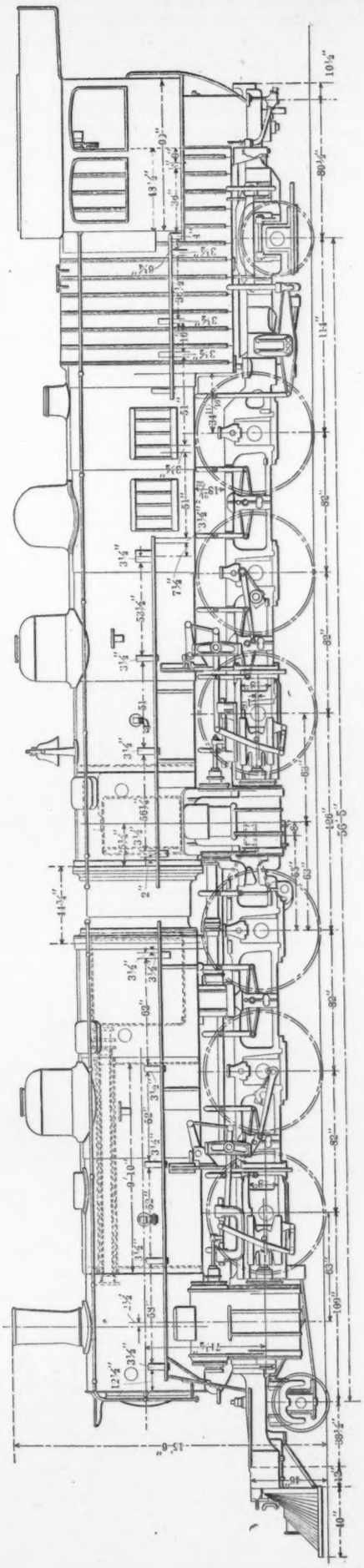
2-6-6-2 TYPE LOCOMOTIVE WITH RIGID SEPARABLE BOILER.



LOCOMOTIVE WITH BELLOWS TYPE ARTICULATED BOILER.



LOCOMOTIVE WITH BALL JOINT TYPE ARTICULATED BOILER.



GENERAL ELEVATION OF LOCOMOTIVE WITH BALL JOINT TYPE OF ARTICULATED BOILER AS DESIGNED BY THE BALDWIN LOCOMOTIVE WORKS.

conical. Experience with this type of firebox and boiler has shown the desirability of taking the steam from a point as near the firebox as possible, and since it was desired to have an external steam pipe between the throttle and superheater two domes were employed. The forward one, however, is simply a throttle chamber and is separated from the boiler by a horizontal plate. The steam enters the rear dome, passes through a piece of netting which assists in catching the suspended water, and is then conveyed forward through two 5-in. pipes to the forward dome, where it enters the throttle valve. This valve is designed to take steam from the top only. The dry pipe then passes out through the front of the dome, and has a flange which is riveted to the dome on the inside, the joint being made tight by a copper gasket. This pipe is fitted with a slip joint and leads forward along the top center line of the boiler, entering the superheater at a point just ahead of the separable joint in the boiler shell. This combined superheater and reheater occupies the full section of the boiler shell at this point and therefore the entrance to it is made through a ground joint on the top of the shell. The steam on leaving the superheater passes out through two pipes on the underside of the boiler shell and is conveyed back to the high pressure steam chest. These pipes are fitted with slip joints with packed glands and are arranged to be easily separated since they pass the separable joint of the boiler. The exhaust from these cylinders passes through similar pipes to the bottom of the reheater and after passing through this enters the flexible receiver pipe, which has a vertical slip joint connection with the steel casting reinforcing the bottom of the reheater outside the boiler shell and a ball joint just beyond the elbow. There is, of course, the usual ball joint at the low pressure cylinders and the arrangement of pipes at this point is the same as previousy used by this company.

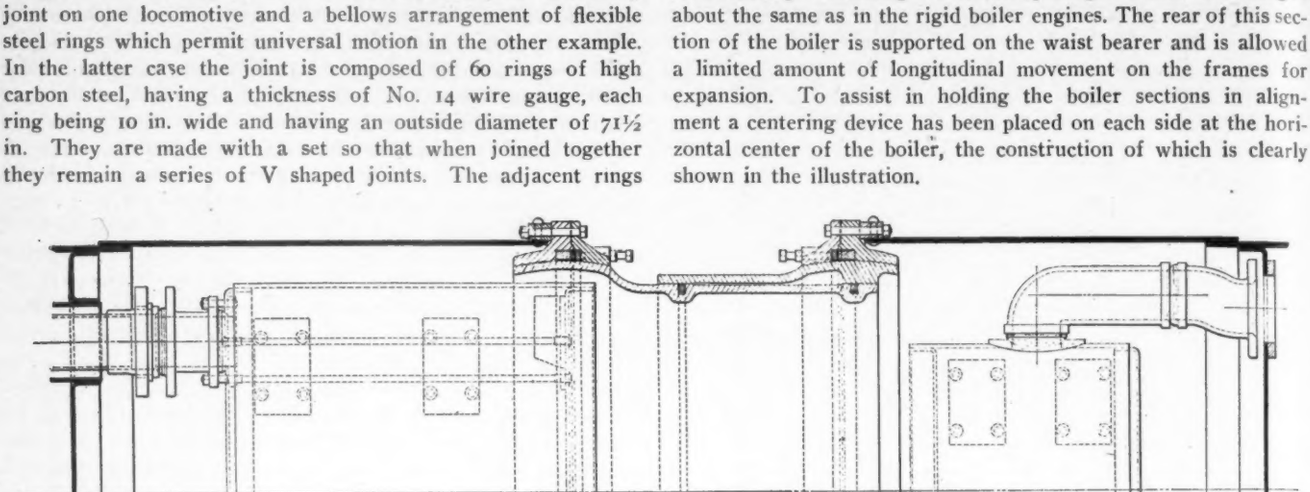
Ahead of the reheater there is a combustion chamber with the manhole in the top center line of the boiler and ahead of this is the feed water heater, which occupies the full section of the boiler shell and has 340 2¼-in. tubes, 7 ft. 8 in. long, giving a heating surface of 1,516 sq. ft. The superheating surface is 300 sq. ft. and the reheating surface 650 sq. ft.

The high pressure cylinders are independent castings bolted to the double front rails of the rear frame. The valves are 13 in. inside admission piston valves with cast iron bodies and L shaped packing rings sprung on. The cylinders are placed 88 in. between centers and the steam chests are at 100 in. centers, which permits the Walschaert valve gear to all be placed practically in the same vertical plane. Since the main rods are connected to the second pair of wheels a very compact arrangement of valve motion has been designed, with the link and reverse shaft mounted on the guide yoke. The low pressure cylinders are also independent castings bolted either side of the steel box casting, which constitutes part of the front frame system, this being the usual construction of these builders. A compressed air power reversing mechanism is used, being of the Ragonette type, which has been applied to a large number of Mallet locomotives, usually, however, operated by steam.

In respect to the frames, which are of steel, the arrangement of the articulated joint and other features, these locomotives present no novelties. In accordance with the latest practice of the builders the vertical hanger bolts customarily used at the articulated connection for equalizing the loads on the front and rear frames have been omitted and the rails of the rear frame are extended forward between the upper and lower rails of the front frame and a slight amount of vertical clearance is provided. Any transference of load at this point is then effected by actual contact between the frames.

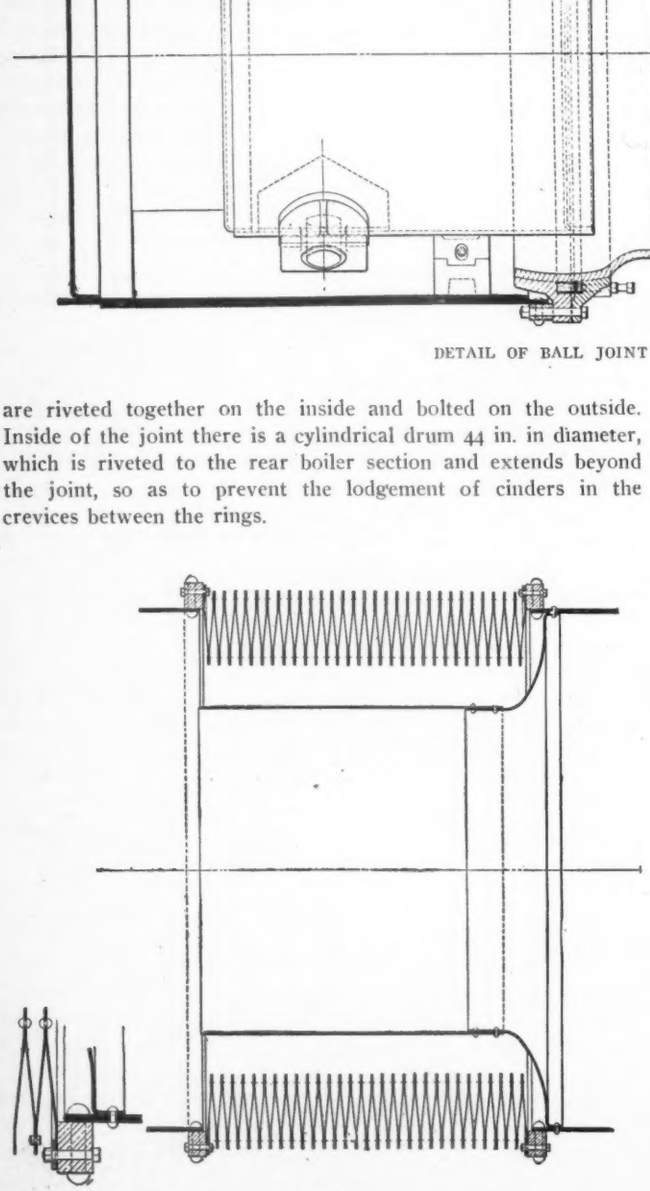
It is the two locomotives fitted with flexible boilers that present the source of greatest interest. The long overhang of the rigid boiler on sharp curves of course disturbs the center of gravity of the whole locomotive decidedly and increases the clearance in some cases to a considerable extent. It has, therefore, been thought advisable by the Santa Fe to experiment with the possibilities of a flexible boiler in which the front section would be rigidly attached to the front group of frames and move with them. This joint is placed in the combustion

chamber just ahead of the high pressure cylinders and two arrangements are being experimented with. Since this joint is located somewhat ahead of the articulated connection between the frames, it is subjected to a combination turning and sliding motion, and therefore consists of a double ball joint and a slip joint on one locomotive and a bellows arrangement of flexible steel rings which permit universal motion in the other example. In the latter case the joint is composed of 60 rings of high carbon steel, having a thickness of No. 14 wire gauge, each ring being 10 in. wide and having an outside diameter of 71½ in. They are made with a set so that when joined together they remain a series of V shaped joints. The adjacent rings



DETAIL OF BALL JOINT IN ARTICULATED BOILER.

are riveted together on the inside and bolted on the outside. Inside of the joint there is a cylindrical drum 44 in. in diameter, which is riveted to the rear boiler section and extends beyond the joint, so as to prevent the lodgement of cinders in the crevices between the rings.

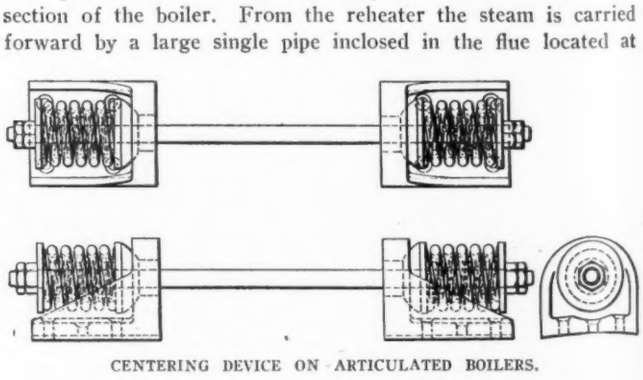


ARRANGEMENT OF BELLOWS CONNECTIONS.

On these locomotives the superheater and reheater are separate both from each other and the boiler shell, being of practically the same arrangement as has been in service on this road on the Mallet passenger locomotives mentioned above. The superheater is in the rear section and the reheater in the forward section, which makes it necessary to have flexible joints on the exhaust pipes from the high pressure cylinders only.

The front boiler section is made somewhat longer and is secured to a low pressure saddle, that is mounted on top of the steel casting containing the steam passages which is arranged about the same as in the rigid boiler engines. The rear of this section of the boiler is supported on the waist bearer and is allowed a limited amount of longitudinal movement on the frames for expansion. To assist in holding the boiler sections in alignment a centering device has been placed on each side at the horizontal center of the boiler, the construction of which is clearly shown in the illustration.

On these boilers the dry pipe is internal and the connections between the superheaters and high pressure cylinders are also made inside the boiler shell. The exhaust from the high pressure is carried through a pair of horizontal pipes fitted with ball and slip joints which terminate in the cast steel waist bearer that spans the front frames and supports the rear ends of this section of the boiler. From the reheater the steam is carried forward by a large single pipe inclosed in the flue located at



CENTERING DEVICE ON ARTICULATED BOILERS.

the top of the feed water heater and is carried down to the connection in the low pressure cylinder casting by a single pipe.

It will be noted that because of the elimination of flexible connections to and from the low pressure cylinders, that the number of ball and slip joints in this locomotive is less than those with the rigid boiler. As opposed to this, however, it is necessary to have flexible connections in the injector pipe and in the feed water connection between the heater and the rear section of the boiler. These are made of sections of metallic hose of the proper size.

In the boilers built at the company's shop they use on the combination of the two old locomotives a ball joint, which is placed directly above the frame joint, which in turn is equidistance between the two adjacent driving axles. This simplifies the ball joint to a considerable extent, making it necessary to have but a single spherical section in addition to the slip joint.

The general dimensions, weights and ratios of the locomotives with the articulated boilers are given in the following table:

GENERAL DATA.	
Gauge	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Maximum tractive effort	61,500 lbs.
Weight in working order	392,300 lbs.
Weight on drivers	317,300 lbs.
Weight on leading truck	29,000 lbs.
Weight on trailing truck	46,000 lbs.
Weight of engine and tender in working order	562,000 lbs.
Wheel base, driving	37 ft. 10 in.
Wheel base, total	56 ft. 5 in.
Wheel base, engine and tender	89 ft. 3 in.
RATIOS.	
Weight on drivers ÷ max. tractive effort	5.16
Total weight ÷ max. tractive effort	6.39
Max. tractive effort × diam. drivers ÷ evaporating heating surface	1175.00
Totalevaporating heating surface ÷ grate area	69.00
Firebox heating surface ÷ total heating surface per cent	6.48
Weight on drivers ÷ total evaporating heating surface	88.00
Total weight ÷ total evaporaitng heating surface	108.20
Volume equivalent simple cylinders, cu. ft	20.60
Total evaporating heating surface ÷ vol. cylinders	175.00
Grate area ÷ vol. cylinders	2.54
CYLINDERS.	
Kind	Compound
Diameter	24 and 38 in.
Stroke	28 in.
VALVES.	
Kind	Piston
Diameter	13 in.
Lead, constant	¼ in.
WHEELS.	
Driving, diameter over tires	69 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	10x12 in.
Driving journals, others, diameter and length	9x12 in.
Engine truck wheels, diameter	31¼ in.
Engine truck, journals	6½x12 in.
Trailing truck wheels, diameter	40 in.
Trailing truck, journals	8x14 in.
BOILER.	
Style	Straight
Working pressure	220 lbs.
Outside diameter of first ring	70 in.
Firebox, length and width	119¾x63¼ in.
Firebox plates, thickness..Sides & crown, 5-16 in.; back, ⅜ in.; tube, 9-16 in.	
Tubes, number and outside diameter	204—2¼ in.
Firebox, water space	F. & B., 5 in.; S., 5½ in.
Tubes, length	19 ft. 7 in.
Heating surface, tubes	3,376 sq. ft.
Heating surface, firebox	234 sq. ft.
Heating surface, total evaporaitng	3,510 sq. ft.
Superheater heating surface	390 sq. ft.
Feed water heater tubes—No. & dia	322—2¼ in.
Feed water heater tubes, length	9 ft. 10 in.
Feed water heater, heating surface	1,893 sq. ft.
Reheater, heating surface	719 sq. ft.
Grate area	52.5 sq. ft.
Smokestack, height above rail	186 in.
Center of boiler above rail	107 in.
TENDER.	
Tank	Waterbottom
Frame	12 in. channels
Wheels, diameter	34¼ in.
Journals, diameter and length	5½x10 in.
Water capacity	9,000 gals.
Coal capacity	12 tons

FOURTH ANNUAL APPRENTICE INSTRUCTORS' CONFERENCE

NEW YORK CENTRAL LINES.

The fourth annual conference of the apprentice instructors of the New York Central Lines was held at the Grand Central Terminal, New York, on January 27, 1911. All of the apprentice instructors, numbering 22, from the ten shops on the system where schools are maintained, were present. C. W. Cross, supervisor of apprentices, assisted by Henry Gardner, assistant supervisor, had charge of the meeting. A number of general officers from the system were present, among them being the following: J. F. Deems, general superintendent of motive power; F. E. McCormick, division superintendent; F. W. Brazier, superintendent of rolling stock, and E. B. Katte, chief engineer of electric traction. Among the guests were G. M. Basford, assistant to the president of the American Locomotive Company; W. L. Davis, apprentice instructor of the Santa Fe, and W. B. Russell, director of the Franklin Union, Boston, Mass.

The meeting was opened with an address by G. M. Basford, who spoke on the subject of "The New Apprenticeship." Mr. Basford briefly outlined the conditions which surrounded an apprentice boy of 20 years ago and stated that it is not surprising that kind of an apprenticeship was a failure. He pointed out the wonderful differences of the present systems, as illustrated by the New York Central Schools, and stated that he did not believe that if the work is continued along its present lines, it can possibly fail to accomplish the results desired. He pointed out to the instructors present the peculiar advantages which they have and also the peculiar responsibility resting upon them. They labor under an almost ideal condition, as concerns the pupil and teacher, and have much more control over and influence on the whole future of their pupils than do any other class of teachers.

Speaking along these lines, Mr. Basford closed his address with the following paragraphs:

You are dealing with boys in the most impressionable age of their lives. They are at the age when the influences of home, of the church and of the public schools are likely to be weak or altogether wanting. The boys are perhaps away from home, but if at home they are drifting rapidly toward manhood and are forming the habits of their lives as to thought as well as in the occupation of their hands. They are about to establish their ideals and select companions whose influence is likely to last throughout their lives. In short, they are embryo citizens beginning to realize the independence which comes from earning their own living. At this stage you are thrown in contact with them more closely than is any other human influence. You may impress them with your own personality, your own ideas, outlook and hopes, you may bring before them standards which they will adopt. You may not do any of these things. Your influence depends very largely on your own personality, your knowledge of boys and boyhood and your ability to acquire close proximity to their lives. Perhaps you may not realize the importance of this contact, but it seems reasonable to expect that if you can get upon such close footing with them that they will trust you with their troubles, ask your advice and take you into their confidence, you will be able to mold their future to a very large extent. Do you appreciate your responsibilities in this direction?

Nothing is to be feared from the influence of any man skilled with his hands and developed in his mind for independent thought and action, but much is to be feared from a large class of workmen skilled or unskilled who allow others to think for them and who are morally weak in that they will not act with the courage of their own convictions. It seems to me that the greatest problem before the instructors of apprentices to-day lies in that part of the work which has to do with conscience and citizenship, and that in this direction lies the greatest opportunity for apprenticeship development. In this lies your greatest responsibility. If you do not realize it you fail to accomplish the greatest of all the objects lying before you.

A great deal may be accomplished through apprentice organizations, debating clubs, athletic teams and other influences which tend to develop individual initiative in connection with the team work idea. Boys need to manage something to develop self-government in order to realize that the world has a right to expect them to take their places in the human organization of life in general and in order that they may become self-reliant units in that organization.

Summing up I would like to lay before you three facts: You are working under ideal conditions as to the relationship between instructor and pupil. This relationship renders it possible for you to exert most powerful influences over the character and the future of your students. The most vital object of this whole movement is to produce men, American workmen, skilled, resourceful, honorable men, men prepared and inclined to fulfill their obligations.

F. H. Colvin, managing editor *American Machinist*, spoke briefly on the subject of "The Conservation of Workmen," drawing attention to the fact that nearly all the States are paying considerable attention to the problem of compensation for injured workmen. He pointed out how the apprentice instructors could do very much to reduce the possibility of injury through proper training of apprentices and in this way help reduce the economic loss, both to the individual and the community, that is always present in the case of a serious injury to a workman.

J. F. Deems complimented the instructors present most highly on what they have done and what they are now doing. Mr. Brazier and Mr. Katte also spoke briefly to the same point.

In opening the conference Mr. Cross spoke in part as follows:

It is gratifying to know that there are now at least twelve railways in the United States where a systematic course of apprentice instruction is being pursued with marked success. Skilled instructors are leading the young mechanics through graduated courses to a thorough knowledge of their calling and the results are so far most encouraging. The important element of natural selection is markedly active in many of the shops. Under proper instructions it is speedily recognized whether the young man has made the proper choice of a calling or not. The unfitted are weeded out and directed to other fields. The moral and intellectual tone of the student apprentice is elevated. Life becomes sweeter and higher and nobler when the difficulties of a calling are illumined by intelligent and kindly instruction. The burden of labor lies lightly on the shoulders of the studious youth who can call the gathered wisdom of a proficient instructor to his aid. To this is added another important factor—that the amount of work or output of the apprentice shows a marked increase where there is an instructor. Hence the apprentices under the new system are being better paid, with the result that instead of being a burden on their parents or guardians during their apprenticeship, the young mechanics are self-

supporting from the beginning, and when they graduate they have the proud consciousness of knowing that they are fitted to take part in the world's work without fear or favor.

On March 1, 1906, the apprenticeship department was created and a few weeks later the work was well started at nine of the shops. We have completed the cycle of the work and the graduates now turned out have had the full four years course of training. The courses of study have been revised and improved and specialized to fit the several trades in a manner that has met with the approval of all interested persons. The graduates are used to good advantage in the service, and as a proof of the efficiency of the training system, when graduates are re-employed as mechanics at the completion of the apprenticeship they are given a generous rating, and in many cases the maximum rate in the trade in which they are re-employed."

The annual statistical report presented by Mr. Gardner showed that on July 1, 1910, there were 617 apprentices enrolled, an increase of 62 over the previous year. Fewer apprentices had been discharged than any previous year, showing closer attention to the weeding out of undesirable material during the six months probationary period.

The question of the possibility of getting the standard for apprentices too high was brought up for discussion. It seemed to be the consensus of opinion of the speakers that high school graduates made the best class of apprentices. Mr. Rauch, drawing instructor at Oswego, stated at the conference three years ago that he preferred apprentices from the seventh or eighth grade of public schools to those who had had a high school education. He now stated in this discussion that he had been compelled to change his mind and was willing to take all the high school boys he could get.

On the subject of giving prizes for particularly good work, it seemed to be the consensus of the meeting that it would be unwise to institute this policy.

The importance of allowing an apprentice to develop initiative and self-confidence as far as possible was brought out in the discussion of the subject, "Results of Modern Apprenticeship," which was opened by F. Deyot, Sr., of East Buffalo.

A course for electrical apprentices was outlined by C. A. Towsley, of Elkhart, which aroused considerable discussion. Mr. Russell stated that the results in Boston seem to demonstrate that successful instruction in this field requires the use of electrical apparatus in a laboratory and suggested the advisability of equipping an instruction car with such apparatus for the use of all the shops on the system.

In connection with the discussion on the subject of monthly reports for the parents, it was the opinion of the meeting that some kind of a simple report, which could be sent to the parents each month indicating the standing of the apprentice in his school and shop work, would be productive of good results.

Other subjects which were introduced and discussed, included the following: "Laboratory Work," "Walschaert Valve Gear," "The Backward Boy," "Loyal and Satisfied Apprentices," "Results" and "Car Builder Apprentices."

A paper prepared by one of the apprentices at Oswego, showing the value of the apprenticeship instruction as seen from the standpoint of an apprentice himself, was read at the meeting. Part of this paper is given below:

Every mechanic expects the apprentice to "hop" to his music; every apprentice knows the mechanic will "kick" to his tune, for the mechanic has no time for the "greeny." The only man who understands apprentice language is the "angel," which is slang for shop instructor, but it is no miss to call him such, for without him the greeny would never grow, but would be at a standstill half his time. Sometimes we wish the angel was twins, even triplets would no morer than meet the demand. * * * *

The rate paid a first year apprentice is out of propotrion to his needs; even a first yearer must eat like a man and dress as a man in order to work like a man; he looks like a man and feels like a man until he puts his hand in his pocket. The apprentice who clothes himself, buys tools, carries some protection, pays apprentice club dues, church and shop collections, is obliged to pay his nearest relatives for board, washing and mending in "promisosry notes" (no time of payment specified), must be blind on the girl side of the road and put the curb on a growing sociability. All this hurts; it might be called, "apprentice cramp"; it squeezes the region of the short rib and produces imperfect vision. A dime looks the size of a car wheel and it makes as many revolutions in his pocket as one going a mile a minute before it disappears into spend-land. I might go further and say it leads to defective hearing, for the jingle of small coin is so sweet to the ear that many a fellow adds keys, nails and tool checks to swell the sound so that in time he becomes stone deaf to the ring of real money. Apprentice cramp is a disease that carries off many of the first yearers and deters many other desirable fellows from becoming apprentices. Another trouble is the discovery that physically he is not adapted to the trade he has started, yet rather than start another at first year rate he drops out. This is a loss to the railway as well as to the boy and it's up to them to remedy it. The high school boy of to-day is more inclined to mechanics than ever before if the rate paid was more proportional to his wants.

The classroom is the smoothing iron that rubs out all the wrinkles of discontent, for the apprentice looks forward to these hours with pleasure. "Up to the college," has almost the ring of "come on to the ball game," and the class instructor is regarded as a 'dad' by all the boys. Even the fellow who went in with a sneer goes out with a thank you. Next to the school is the club; here the apprentice spreads his wings for his first flight in oratory, here he gets used to hearing his own voice and gets over the scare of the sound of it, here he also sharpens up his wits for defense or his tongue for attack and here he talks railway, reads railway, and grows to be a railroader.

FEDERAL LOCOMOTIVE BOILER INSPECTION BILL

The substance of the bill which, after nearly a year of discussion, hearings and investigation of the subject, passed the Senate on January 10, and the House on February 7 is given below:

Section 1. Applies to all interstate railways.

Section 2. From July 1, 1911, it shall be unlawful to use any steam locomotive in moving interstate traffic unless the boiler and appurtenances are in proper and safe condition to move traffic without unnecessary peril to life or limb; and all boilers shall be inspected [by the roads], in accordance with rules to be prescribed, and be able to withstand tests provided by such rules.

Section 3. The President, by and with the advice and consent of the Senate, is to appoint a chief inspector of locomotive boilers (salary $4,000) and two assistant chief inspectors (salary $3,000 each).

Section 4. The chief inspector is to divide the country into 50 districts, and an inspector is to be appointed for each district; salary $1,800, with $600 for office rent, stationery and clerical assistance. These 50 inspectors are to be appointed by the Interstate Commerce Commission after competitive examinations, according to the rules of the Civil Service Commission. The chief inspector is to prepare a list of questions, which, when approved by the Interstate Commerce Commission, is to be used by the Civil Service Commission as a part of its examination.

Section 5. Each carrier shall file its boiler inspection rules, which, after hearing and approval by the commission, shall be come obligatory on such carrier. If the rules are not duly filed, the chief inspector shall prepare rules for that carrier. A carrier may change its rules from time to time, on approval by the Interstate Commerce Commission. The general rules for the inspectors are to be prepared by the chief inspector and approved by the commission.

Section 6. Each inspector is to become familiar, so far as practicable, with the boilers in his district; and make personal inspections from time to time as may be necessary to carry out the law and as may be consistent with his other duties. His first duty shall be to see that the carriers obey the law and repair defects promptly. Each carrier must send to the inspector duplicate sworn reports of each inspection and also of what has been done to repair defects found by inspection. An inspector finding a boiler out of order is to notify the carrier in writing and thereafter the boiler must not be used until repaired. Within five days the carrier may appeal to the chief inspector for re-examination and another man must then re-examine, within 15 days; if still dissatisfied, the carrier may within 30 days appeal to the commission, which may overrule the inspector or the chief inspector. Pending either appeal, the inspector's first decision shall stand.

Section 7. The chief inspector shall make an annual report to the commission.

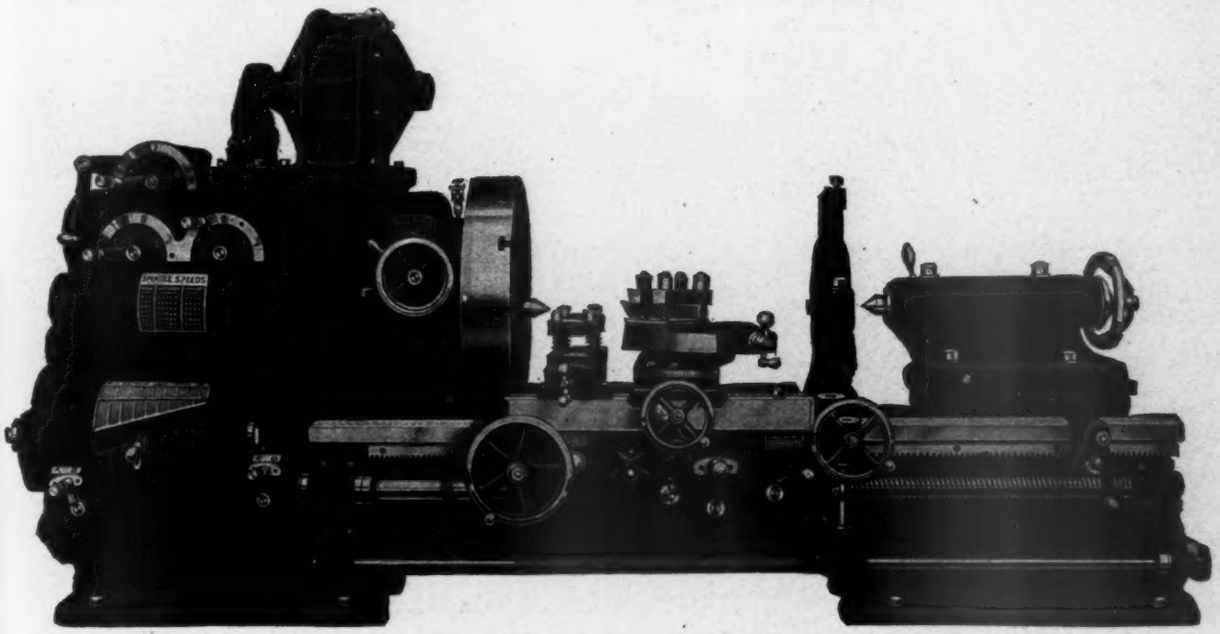
Section 8. Boiler accidents resulting in serious injury or death must be forthwith reported in writing and the chief inspector shall investigate or order investigation. Parts of damaged boilers must be kept so that they can be seen by the inspectors. The commission may at any time call on the chief inspector for a report of any accident and may publish the same with recommendations. Such reports must not be used as evidence in suits for damages.

Section 9. Penalty for violation $100.

DEVELOPMENT OF THE HIGH DUTY LATHE

The powerful machine shown in the illustration, designed and built by the American Tool Works Co. of Cincinnati, O., represents the latest developments in high duty lathes, and in power, range of work and convenience is an advance over similar sizes of previous design. Some idea of the enormous power of these lathes may be gained from the fact that for motor drive the builders recommend a 20 h.p. motor, and guarantee the machine to work without strain under continuous service of 50 per cent. overload of the motor. Although these lathes are strictly new in design they are by no means still in the experimental stage, as the builders have installed several lots, and in every case they have exceeded expectations.

An analysis of these machines is replete with interest. The severe duty required of a lathe of this size has been given most careful study and every vital point is fully developed. The exceptional solidity of the machine deserves particular mention, as an abundance of metal is used just where it is needed to insure the utmost rigidity, thereby overcoming practically all chatter and vibration, and resulting in true, smooth work. A minimum of power is wasted throughout the drive because of the reduction in the number of running parts, together with the most direct form of drive to the main spindle and through the feed gears. This, coupled with excellent lubrication, insures the highest percentage of power delivered to the tool. Steel gears, which are liberally distributed throughout the machine where experience has shown them to be necessary, are of the coarsest pitch practicable, and cut from the solid with special cutters, no range cutters being used.



NEW AMERICAN HIGH DUTY LATHE WITH MOTOR DRIVE.

The lathe bed is of deep section, exceptionally heavy, and thoroughly braced by cross box girths at short intervals its entire length, a construction which affords a degree of rigidity sufficient to resist the heaviest cuts without vibration. This is the American Tool Works Co.'s patented drop "V" pattern, which gives great additional swing, and permits of deepening the carriage bridge more than is possible with the "standard" form of bed. The bed is further strengthened by a web cast through the center, which carries a rack for engaging the pawl dropped from the tailstock. The "Vs" are large and accurately scraped, and the wall at the tailstock end is cut out to permit of slipping the tailstock off without taking out the bolts. The gear box and lead screw bearing are seated with tongued and groove fit, thereby securing accurate and permanent alignment. The steel feed rack is of best quality, with teeth cut from a solid bar.

A constant speed motor either of the direct or alternating current type is located on top of the patented geared head, which is the triple geared type, and is connected to the main driving shaft through spur gearing. Sixteen spindle speeds are obtainable through a medium of positive clutches and slip gears, the clutches being of the selective type easily engaged, while the teeth of the slip gears are machine rounded, thus causing them to slide easily into mesh, on the same principle as many automobile transmission gears. The gears are all mounted on long bronze sleeves which are oiled by means of eight feed oilers from the outside of the head. A distinctive feature in this new design is the fact that of the 16 speeds provided, 8 are obtained directly through the spindle gear and the other 8 through the face plate drive. It will be recalled in this connection that in the usual type of triple geared lathes only one-third of the speeds are obtained through the face plate drive. This arrangement necessitates using the spindle gear drive for a great deal of heavy turning on large diameter work. In the case of the new machine under consideration this is handled through the face plate drive, thus relieving the spindle of the enormous strain.

The fundamental speed changes are made through the manipulation of the levers on front of the headstock. The motor speeds can be comparatively high, 700 to 1,000 r.p.m., thereby keeping down the size as well as the first cost. All of the speed changes can be made without stopping the central drive, as the machine may be started and slowed by means of a friction clutch which engages and disengages a driving pulley or motor gear from the shaft. This clutch is operated by lever with a very sensitive control, thus enabling the operator to quickly make the various speed changes. The positions of the lever for the various spindle speeds are plainly indicated on the index plate on the front of the head. This plate has been very carefully worked out and every lathe operator will appreciate its simplicity and the ease with which each spindle speed is obtained.

One of the most notable features of these new lathes is the rapid change gear mechanism. All gears at this point are of steel, the material used being of the very best obtainable, either of bar steel or drop forgings. The mechanism is embodied in a self-contained unit carried on the front of the bed and provides 32 fundamental changes of threads ranging from one to 14 per inch. In addition to this a compound quadrant gear is provided on the end of the bed which will furnish 16 additional changes, thus affording 48 thread and feed changes, ranging from one-half to 28 threads, including 14½ pipe thread, and from 4 to 244 cuts per inch. The 32 changes in the box are

all obtained through the medium of a cone and tumbler gear and two sliding clutches of the selective type. Anyone of these changes may be instantly obtained while the machine is running. The quadrant mentioned also provides means for obtaining through loose gears any odd rates or feeds which may from time to time be desired. The cone gears are all of the Brown & Sharpe 20° involute pointed design which provides an exceptionally strong type and greatly facilitates the engaging of the gears while running.

One great feature of this quick change mechanism which is distinctively superior and cannot be found in other designs, is that which eliminates the necessity of speeding up at any time for any of the different feeds or threads. The coarse threads and feeds are all obtained through the cone, and no member in the box at any time runs faster than the initial driving gear. The value of this construction must appeal to those interested in and familiar with lathes. The index plate completely worked out is in full view of the operator on the front of the gear box, and shows the exact setting for each thread or feed.

The detail construction of the head is of much interest, and in that connection the point is very important that all driving is done either through short shafts or through sleeves, there being no long shafts in torsion at any time, thus eliminating all possibility of binding or chatter. All gears in the driving mechanism are of unusually coarse pitch, and the pinions are made of steel cut from the bar. Another very important point in connection with the head construction is the elimination of all loose gears from the spindle. The spindle is of high carbon, hammered steel, accurately ground, and has a hole 2⅝ in. its entire length. The bearings are of the best quality phosphor bronze, and equipped with sight feed oilers. It is of taper form, a construction common to wheel lathes. The only gear on the same spindle with the driving gear is set close against the front spindle bearing. The spindle is therefore at no time under severe torsional strain. This feature adds greatly to the life of the bearings and the alignment of the spindle.

There are other features worthy of mention such as the ability to draw the rack pinion from the feed rack when cutting threads, the impossibility of simultaneously engaging the feeding and screw cutting mechanism, the fact that all gears and pinions in the apron are of steel, cut from the solid with special cutters; hardened and ground studs and shafts, and the extra heavy carriage which is 13 in. wide and unusually deep. Since a lathe of this size requires easy access to crane service and is frequently operated overtime, it is considered the best practice to provide for individual motor drive. The lathe is then a complete unit and can be operated at any time without running the central power plant. It also overcomes the difficulty of drive experienced when the machine is to be located far from the line shaft or in places where it is not practical or desirable to install one.

STANDARDIZATION OF CHILLED IRON CAR WHEELS*

During the year 1909 the M. C. B. Association recommended as standard three weights of chilled iron wheels, viz., the 625-lb. for cars of 60,000-lb. capacity; the 675-lb. for cars of 80,000-lb. capacity, and the 725-lb. for cars of 100,000-lb. capacity. The performance of these wheels is practically perfect when operating under conditions which can reasonably be interpreted as conforming to those of the three classes of cars. It would naturally be supposed that the equipment of all railways would be divided into three classes so that all items of service relating to the wheel should be proportionate to the 625-lb., 675-lb. and 725-lb. wheel. While this is true of 90 per cent. to 95 per cent. of the equipment, there has been a tendency of late in certain sections to increase the percentage of brake pressure to the light weight of the car, and in the case of refrigerator cars and heavy furniture cars of light capacity, the weight of the car allows a higher braking power in total than corresponds with its capacity. It is of extreme importance that the capacity of the wheel should correspond with the intensity of the braking power of the car.

It is doubtful if one wheel in a million would break in service if applied to such cars as we may reasonably infer are specified in the M. C. B. recommendations for each capacity. It is therefore important that the recommendations be closely studied and followed—they are as follows:

MASTER CAR BUILDERS' RECOMMENDED WEIGHTS OF CHILLED IRON CAR WHEELS.

Weight of wheel	625 lbs.	675 lbs.	725 lbs.
Axle capacity	22,000 lbs.	31,000 lbs.	38,000 lbs.
Gross load	88,000 lbs.	124,000 lbs.	152,000 lbs.
Deduct car capacity	60,000 lbs.	88,000 lbs.	110,000 lbs.
Weight of car	28,000 lbs.	36,000 lbs.	42,000 lbs.
Brake pressure at 70 per cent	19,600 lbs.	25,200 lbs.	29,400 lbs.

NOTE.—80,000-lb. and 100,000-lb. capacity cars calculated at 10 per cent. excess load.

SUMMARY.

	Gross Load.	Brake Pressure.
625-lb. wheel designed for	88,000 lbs.	19,600 lbs.
675-lb. wheel designed for	124,000 lbs.	25,200 lbs.
725-lb. wheel designed for	152,000 lbs.	29,400 lbs.

The brake pressure under the majority of equipment is 70 per cent. of the light load of the car, and using this as standard we may determine the brake pressure corresponding to each wheel. Heat is developed through brake friction; therefore, the brake pressure when continuously applied represents the rate at which heat is being developed, other things being equal, and therefore brake pressures should be proportional to that part of the wheel which resists the temperature stresses—the plate.

The question arises just how to determine the relation of the wheel to the brake pressure. As stated above, we assume that the conditions as laid down by the M C. B. Association are entirely satisfactory, and by considering the braking strength of the plate to vary as the square of its thickness, and its strength in tension when resisting temperature stresses to vary directly as its thickness, Table No. 1 was prepared for and published by the Association of Manufacturers of Chilled Car Wheels.

TABLE No. 1.
Thickness of Plates Required in Cast Iron Wheels to which Brakes Are Applied.

Maximum Gross Load on 8 Wheels.	Thickness of Plates Reqired in Each Wheel to Safely Carry the Load.	Total Braking Power of Car.	Thickness of Plate to Be Added to Take Care of Temperature Stresses.	Required Thickness of Tread.
Pounds.	Inches.	Pounds.	Inches.	Inches.
40,000	.36	12,500	.16	....
50,000	.41	15,000	.19	....
60,000	.45	17,500	.22	1.50
70,000	.48	20,000	.25	....
80,000	.52	22,500	.28	1.62
90,000	.55	25,000	.31	....
100,000	.58	27,500	.34	1.75
110,000	.60	30,000	.37	....
120,000	.63	32,500	.41	1.87
130,000	.65	35,000	.44	....
140,000	.68	37,500	.47	2.00
150,000	.71	40,000	.50	....
160,000	.73	42,500	.53	2.12
170,000	.75	45,000	.55	....
180,000	.77	47,500	.59	2.25
190,000	.79	50,000	.62	....
200,000	.81	52,500	.66	2.37
210,000	.84	55,000	.69	....
220,000	.86	57,500	.72	2.50
230,000	.87	60,000	.75	....
240,000	.89	62,500	.78	....
250,000	.91	65,000	.81	2.50

TABLE No. 2.
Weights of Various Diameters of Wheels with Different Thicknesses of Plates.

Thickness of Plates in Inches.	Weight of Wheels. 36 in. Diam.	33 in. Diam.	30 in. Diam.	28 in. Diam.	26 in. Diam.	24 in. Diam.
.62	640	550	480	440	390	350
.68	665	575	500	455	405	360
.75	690	600	525	470	420	375
.81	715	625	550	485	435	390
.87	740	650	575	500	450	405
.93	770	675	600	520	465	420
1.00	800	700	620	540	480	435
1.06	830	725	640	560	495	450
1.12	860	750	660	580	510	460
1.18	890	775	680	600	525	470
1.25	920	800	700	620	540	...
1.31	950	825	720	640	...	...
1.37	980	850	740	660	...	...
1.43	1010	875	760	...	...	...
1.50	1040	900	...	...	...	...

Table No. 1 divides the required thickness of the plate required in a wheel for ordinary railway service in two parts:

1.—That required to carry the load.

2.—That required to resist temperature stresses as represented by brake pressure.

* Abstracts from a paper read by W. S. Killam at the January meeting of the Western Ry. Club.

The sum of these quantities gives the required thickness of the plate in the wheel.

Table No. 2 has also been prepared for the Association of Manufacturers of Chilled Car Wheels to show the approximate weight of a wheel for all usual diameters when the thickness of plate is specified. With these two tables at hand it requires but a moment to decide whether any wheel harmonizes with the service conditions. The method of using the table is as follows:

Example.—What wheel should be used under a refrigerator car having a gross load of 90,000 lbs. and braking pressure of 37,500 lbs.? Referring to Table No. 1 we have the following:

Thickness of plate corresponding to gross load of 90,000 lbs.....	.55 in.
Thickness to be added on account of 37,500-lb. brake pressure....	.47 in.
Total thickness of plate.....	1.02 in.
Referring to Table No. 2, weight of wheel is.....	700 lbs.

Table No. 1 is for use only when considering cars in miscellaneous service, that is, where cars of all classes are coupled together in one train; the application of this rule is simply to produce a distribution of retarding force to each wheel in proportion to its size. When the trains are made up of the same kind of cars and operated on heavy grades, another principle applies. In this case the wheels are all alike, and the braking

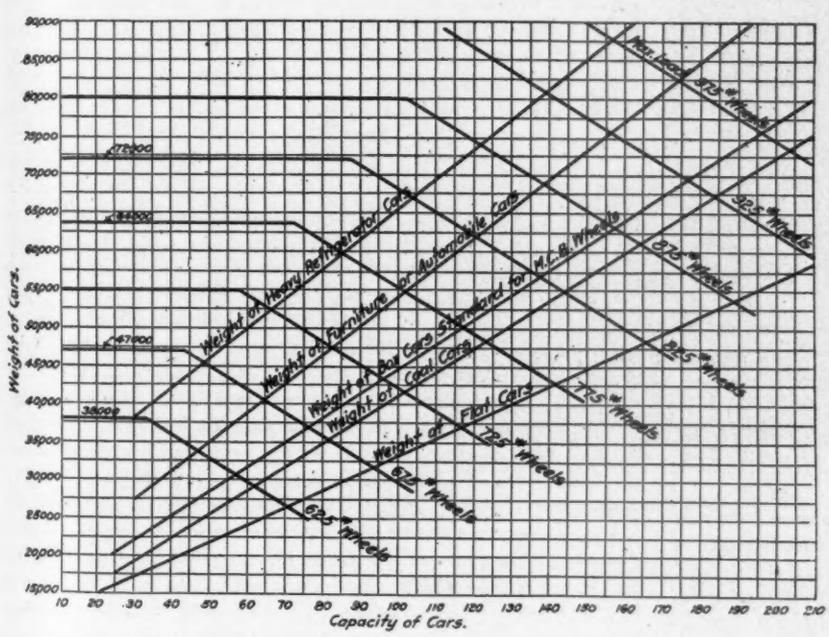

Weight of cars.
Capacity of Cars.
Weight of Heavy Refrigerator Cars
Weight of Furniture or Automobile Cars
Weight of Box Cars Standard for M. C. B. Wheels
Weight of Box Cars
Weight of Coal Cars
Weight of Flat Cars
675 lb. Wheels
725 lb. Wheels
625 lb. Wheels

CHART TO AID IN CHOOSING WHEELS.

power uniform on all cars, hence the rate at which heat is produced is determined solely by average gross load and the rate of grade. In this case it is entirely immaterial how brake pressures are calculated, for it is self-evident that sufficient braking power for each car must be used to offset the gravity effect of the average gross load per car, and no more or no less. To take care of this situation Table No. 3 has been prepared.

This table shows how the weight of the wheel should vary with operating conditions and is intended as a guide for choosing the proper standard wheel to suit any operating condition. From the experience gained in observing the performance of trains made up of fully loaded cars of one kind and operated on 4 per cent. grades, such as often occurs in mining districts, the maximum safe operating conditions for wheels have been established and are shown in Table No. 3.

TABLE NO. 3.

Effect of Gross Load and Grade on Wheel Design.

Gross Load 75 tons.	1%	2%	3%	4%
Thickness plate, in inches, to carry load.....	.71	.71	.71	.71
Additional thickness for grade.....	.15	.30	.45	.60
Total thickness	.86	1.01	1.16	1.31
Weight of wheels, lbs.....	646	706	766	825
Gross Load 60 tons.				
Thickness plate, in inches, to carry load.....	.63	.63	.63	.63
Additional thickness for grade.....	.12	.24	.36	.48
Total thickness	.75	.87	.99	1.11
Weight of wheels, lbs.....	600	650	700	750
Gross Load 50 tons.				
Thickness plate, in inches, to carry load.....	.58	.58	.58	.58
Additional thickness for grade.....	.10	.20	.30	.40
Total thickness	.68	.78	.88	.98
Weight of wheel, lbs.....	575	613	654	692
Gross Load 40 tons.				
Thickness plate, in inches, to carry load.....	.52	.52	.52	.52
Additional thickness for grade.....	.08	.16	.24	.32
Total thickness	.60	.68	.76	.84
Weight of wheel, lbs.....	550	575	604	637

Use of Tables.—These tables furnish a ready means of examining any operating condition of freight cars and freight engine tenders to determine whether the wheels are properly standardized. The tables represent the maximum safe combination of load and braking power that are safe for chilled iron wheels. The safe operating stress for the wheel is governed by the properties of metal of which the wheel is composed. Operating conditions of load, grade and brakage are fixed by the railway. The obvious responsibility of those having charge of standardization of wheels is to harmonize the wheel to the maximum conditions under which it must operate. Tables No. 1 and No. 3 are to be used exactly as tables for the strength of I-beams, channels, angles, etc.

Graphic Chart.—As a further aid in choosing wheels for various conditions, a chart has been prepared which extends beyond the limit of present freight cars. The object of this chart is to show in what classes of equipment brake pressures are likely to be in excess of safe wheel practice. Fortunately the cars at present under which the wheels are not properly standardized are comparatively few, and the remedy is easily applied.

The vast majority of wheels are properly standardized and the improper standards exist in a very small percentage of cars. This is all the more reason why these errors should be corrected. The total percentage of refrigerator cars is only 1.36 per cent., and there is probably about the same percentage of furniture cars. There are several ways in which corrections can be made. The recent tendency is to obliterate the different classes of cars by building a few cars of the smallest capacity, having largest brake pressure, thus placing these cars, as far as the wheel requirements are concerned, in the heavy class, and a wheel should be made to take care of all such non-standard cars.

This wheel would be the 625-lb. wheel with 75 lbs. added to the plates; in other words, what is needed is a heavy wheel with small center core size. The result of such a standard would be the practical elimination of wheel troubles in the important class of cars handling perishable freight where it is important that delays should not occur. If it should be impractical to have a standard wheel for refrigerator and heavy furniture cars, then the alternative is to have but one wheel for all classes of cars. This would be far more expensive, as it would be necessary to increase the weights on 95 per cent. of the 60,000-lb. class of cars because 5 per cent. of this class require heavy wheels. It is not practical to use the present standard 675-lb. wheel for refrigerator cars, for in the first place making the core size smaller would add at least ten pounds to the hub and the weight would then be 685 lbs. It becomes necessary, if the 675-lb. standard is maintained, to take ten pounds of metal from the plates. The tread of the 675-lb. wheel is much heavier than required for the gross load carried by refrigerator cars, hence the final result would be but a slight improvement over the 625-lb. wheel.

Another solution is to abandon the present 675-lb. wheel and use the 725-lb. under both 80,000 and 100,000-lb. cars, because in many cases there is no difference to speak of in these two classes, and better service would be secured in the 80,000-lb. class. The standards would be:

725-lb. wheel for 80,000-lb. and 100,000-lb. capacity cars.

700-lb. for refrigerator, furniture, and other heavy cars of the 60,000-lb. capacity class, and also for 70,000-lb. capacity cars.

625-lb. for ordinary 60,000-lb. and less capacity cars, and the lighter refrigerator cars.

This would be the best solution, as it would take care of all cars of the 80,000-lb. class which have a braking power in excess of that of the average 80,000-lb. class, such as refrigerator cars, furniture cars, etc. The 725-lb. wheel is correct for most 100,000-lb. capacity service. There are a few cases, however, of dairy products cars and special cars of very heavy weight which would require special consideration.

It is the custom with most railways to purchase the three weights of M. C. B. wheels and use them indiscriminately in freight, engint and passenger service, the only item considered being the weight of the wheel and size of journal. Fairly good results have followed from this practice on roads where brakes are seldom applied to prevent too high an acceleration of speed on descending grades, but on heavy grades where the conditions imposed on the wheel are greater than those ordinarily encountered in freight service for the same weight of wheel, special consideration is required. This subject has been given careful consideration during the last two or three years and designs have been developed which answer every service requirement.

In making up the designs for wheels in service under engine tenders the same relation to service conditions are followed as shown in Table No. 1, which is based upon the M. C. B. recommendations for freight service. The difference between engine tender service for a given gross load and freight service for an equal load is that the weight of the tender when empty is much greater than that of a freight car; because the tender is always partially loaded, the braking power is made at a higher percentage than is common in freight service, so that the temperature stresses in tender wheels are very much greater than in any of the cars in the same train; for example:

Let us assume a tender having a capacity of 8,000 gal., using an axle with 5½ in. x 10 in. journals. The items relating to the wheel problem are as follows:

Weight loaded	150,000 lbs.
Weight empty	56,000 lbs.
Brake pressure at 90 per cent	50,400 lbs.

It will be noted that as far as the load is concerned an axle of the same dimensions used under 100,000-lb. capacity cars is sufficient and it is assumed by a good many roads that, therefore, the 725-lb. M. C. B. wheel is equaly as satisfactory as in freight service. This conclusion may be approximately true on roads where there are no grades of sufficient consequence to call for continuous operation of brakes, but on roads having steep grades requiring brake action to control the speed of the train it can readily be seen that the condition is very different from that of wheels under freight cars.

It was shown that the 725-lb. wheel is designed for cars having approximately 30,000-lb. brake pressure. The problem resolves itself to the following:

Engine tender, braking power	50,000 lbs.
725-lb. wheel designed for braking power	30,000 lbs.
Excess braking power	20,000 lbs.
From Table No. 2, 725-lb. wheel has plate thickness	1.06 lbs.
From Table No. 1, excess metal required for 20,000-lb. braking power.	.25 in.
Thickness of plate required for tender wheel	1.31 in.
From Table No. 2 weight of 33-in. wheel, plate thickness 1.31 in.	825 lbs.

This shows that to obtain the same factor of safety under an engine tender having a gross load of 150,000 lbs., as in freight service, that an 825-lb. wheel is required. Wheels of this character will produce the best results.

Another reason why wheels for tender service require a larger section of metal in the plate is that many engines are equipped with straight air brakes which are used independently on the engine. Therefore it is possible to use the brakes on the tender wheels with greater frequency, or with greater intensity, than on the entire train. Also on account of the short wheel base and the high center of gravity of the load, there is more swaying and greater shifting of the load from one wheel to another than in ordinary service. This coupled with the desire to give a higher factor of safety in engine service demands a wheel in which all parts are proportioned to the stresses which are known to apply to the wheel.

Table No. 5 shows in general the weights of wheels which should be used in engine tender and engine truck service.

TABLE No. 5.
Weight of Engine Tender Wheels.

Capacity, Gals.	Weight of Tank.	Total Load.	Thickness of Plates in Inches.	Weight of Wheels.	Size of Journal.
3,000	21,000	60,000	.68	600	3¾ x 7
4,000	28,000	80,000	.75	600	4½ x 8
5,000	35,000	100,000	.87	650	4¾ x 8
6,000	42,000	120,000	1.00	700	5 x 9
7,000	49,000	140,000	1.12	750	5 x 9
8,000	56,000	160,000	1.25	800	5½ x 10
9,000	63,000	180,000	1.37	830	5½ x 10
10,000	70,000	200,000	1.50	860	6½ x 12

Weight of Engine Truck Wheels.

Diameter.	For Less Than 6,000 Pounds Pressure.	For 6,000 to 12,000 Pounds Pressure.	For 12,000 to 16,000 Pounds Pressure.
24 ins.	410 lbs.	450 lbs.	480 lbs.
26 "	460 "	500 "	535 "
28 "	510 "	560 "	600 "
30 "	575 "	635 "	680 "
33 "	650 "	735 "	800 "

A great many passenger cars are equipped with chilled iron wheels and no failure has been reported in years in regular passenger service.

TABLE No. 6.
Weight of Passenger Car Wheels.

Capacity. Whl.	Trk.	Weight of Car.	Total Load.	Thickness of Plates in Inches.	Weight of Wheels.	Size of Journal.
8	"	20,000	35,000	.68	600	3¾ x 7
8	"	30,000	45,000	.68	600	3¾ x 7
8	"	40,000	55,000	.81	625	3¾ x 7
8	"	50,000	65,000	.93	675	3¾ x 7
8	"	60,000	80,000	1.06	725	3¾ x 7
8	"	70,000	90,000	1.18	775	3¾ x 7
8	"	80,000	100,000	1.31	815	4¼ x 8
12	"	80,000	100,000	1.00	700	4¼ x 8
8	"	90,000	110,000	1.43	845	4¼ x 8
12	"	90,000	110,000	1.06	725	4¼ x 8
8	"	100,000	120,000	1.56	875	5 x 9
12	"	100,000	120,000	1.12	750	4¼ x 8
12	"	120,000	140,000	1.31	815	4¼ x 8
12	"	140,000	160,000	1.43	845	4¼ x 8

The weight of wheels for passenger service is shown in Table No. 6. This is based largely on Table No. 1, although it is self-evident that the factors for passenger service are different than those for freight service in that the tonnage to be controlled by the brakes is less, and therefore, for continuous application of the brakes less braking power is required. However, as passenger trains require special factors of safety, the wheels should not be lighter than shown in Table No. 3 for 4 per cent. grades. Chilled iron wheels were used under the first Pulman coaches, but as the coaches grew heavier the service became too severe for the then existing designs of chilled iron wheels, viz., 650 lbs. for 36-in. wheels, and inasmuch as there was no heavier design for the chilled iron wheel at that time, a change was made to the heavy steel-tired type of wheel. The service on passenger cars is not nearly so severe as in heavy freight and engine service, and therefore the chilled iron wheel, if of proper weight, is eminently adapted to this traffic as indicated by the large number of cars equipped with them in constant service year after year with no wheel failures.

It is almost self-evident that wheels should not be purchased as freight wheels and used indiscriminately in engine and passenger service, for the reason that the operating stresses in the wheel are not the same in both cases. The process of selection is thoroughly recognized in all materials entering into the construction of passenger equipment and should be extended to the wheels, which are the most important part of the structure.

Large sums of money are spent to procure safety in other directions, while practically nothing is allowed the chilled iron wheel maker for producing the best that can be made for this service. Where it is known that wheels are ordered for passenger and engine service, special selection can be made in the foundry of the taps from which they are poured, special treatment in annealing and special tests after the manufacture has been completed can be applied

The same rules apply here as in the manufacture of any other article. There is an opportunity for selecting from the mill run of any product in order to secure the most select for any special service. Also during the last two years considerable progress

has been made in the use of alloys which can be shown to definitely improve not only the wearing quality, but the stability of the wheel from structural failure. It is evident that where expensive alloys are used and where special manufacturing consideration is given to a lot of wheels that there must be an increase in the manufacturing cost. This, however, is very slight in most cases, and is returned to the railway in the way of extra service, extra guarantees, etc.

The question of safety in the use of chilled iron wheels is often discussed. Safety is a relative term and whether one type of wheel is more safe than another depends on a careful record showing percentages of failures. The results in service show that no type of wheel is entitled to the distinction of being "absolutely safe" and when we begin to apply the percentage of failures, often the wheels that are supposed to be the most safe are compelled to relinquish this claim to some other type. Where the rules laid down in this article are followed, there will not be one broken wheel in one million in the chilled iron class. The study of the metallurgy of the chilled iron wheel shows the metal to be ideal for the purpose for which it is used, that is, the maximum amount of service and reliability at the least cost.

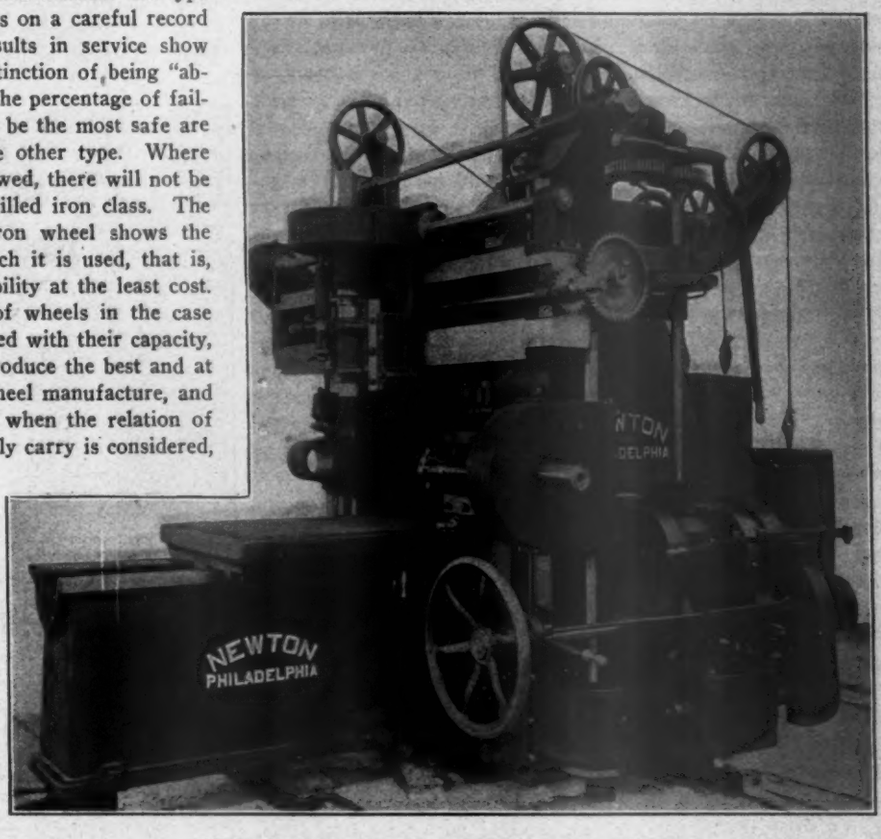
Considering the present misapplication of wheels in the case of cars of heavy braking power, as compared with their capacity, and in the adaptability of chilled iron to produce the best and at the same time the cheapest material for wheel manufacture, and on account of the reliability of the wheel when the relation of the metal to the stresses which it must safely carry is considered, we have no hesitancy in recommending the chilled iron wheel for all classes of railway service which now exist, and we see no indication of having reached the limit; in fact on account of the absence of ductility in the metal of the tread it is better suited than any other material for highly concentrated loads. For special cases, such as crane and turn-table service, where 100,000 lbs. are carried per wheel, we have no hesitancy in furnishing standard designs of chilled iron wheel.

From tests we have made, we are positive that if allowed a reasonable advance to permit greater care in manufacture and closer inspection on lines which are not now covered by standard inspection rules, and if the wheels are ordered specially for each class of service, as outlined in this paper, we can furnish not only the most economical, but the safest wheel made of any material, and guaranteed to stand any service that the strongest car or rail can carry, for any capacity or in any service, and that the proportionate ratio of comparative safety and wear will increase in proportion with the load.

VERTICAL AND HORIZONTAL MILLING MACHINE

It will be noted that this machine has about all the features that can be desired for general utility, yet is very flexible in its operations, and is therefore adapted to the different classes of work in railroad shops on account of the convenient location and small number of operating levers, and the fact that one transmission serves for all the moving parts. The machine is also so designed that the side head can be placed on either side, the right or left hand upright, or one on each upright, and two on the cross rail.

The diameter of the spindles in the adjustable saddles is 4 in.; in the sleeve of the driving worm, 3⅝ in.; independent hand adjustment to spindles, 8 in., and diameter of spindle driving worm wheel, 19 in. The maximum distance between the uprights is 45 in.; maximum height under vertical spindle, 25 in.; maximum height center of horizontal spindle to top of the work table, 17 in.; and maximum distance between horizontal spindle and opposite upright, 36 in. Both spindles are identically of the same design, and revolve in bronze bushed capped bearings in the saddles, having vertical hand adjustment with micrometer measuring guides, and are driven by sleeve worm wheels by means of double splines. The driving worm wheels have a bronze ring with teeth of steep lead and hardened steel, and the driving worm is of hardened steel fitted with roller thrust bearings, both of which are encased and run in oil. Special provisions to prevent the escape of oil are made, the flange being cast solid with the saddles, extending 2 in. beyond the hub on the driving worm, and the driving spline shafts are fitted with bushings that revolve with them, preventing the escape of oil through the splines, as would occur if the shafts had a direct bearing on the bushings.



LATEST DEVELOPMENT IN NEWTON MILLING MACHINE.

The spindles are arranged to drive the cutter arbors by means of a broad faced key, and to hold these in place by a through retaining bolt. The spindle saddles are arranged with the new Newton system, which has the adjustment by means of taper shoes, putting the stress only on each edge of one shear for each surface, thus overcoming the distortion of surface which existed under the previous practice of having the bearings on both outside edges of the rail or uprights. The horizontal spindle saddle and outboard bearing are counterweighted, have hand vertical adjustment by means of a rack placed on the front of the uprights, and the adjacent faces of the spindle saddle and outer bearing, and of the rail, are finished, permitting of their attachment to maintain alignment when using an arbor in a horizontal spindle or for their elevation by power in unison with the rail. The drive for the vertical spindle is clutched, and by this means either of the spindles can be run independently, or they can be operated in unison as desired. Motion for the feed and fast power traverse is taken from a double train of bevel gears shown on the right hand side of the machine, to the feed and speed box, which is the standard Newton construction. The drive for the vertical spindle can be engaged or disengaged from either side of the machine.

The cross rail is of box type construction; is counterweighted; has reversing fast power vertical adjustment, and feed with nine changes, and the alignment is maintained by having a bearing on both sides or only one shear. On the right hand up-

right, elevating screws have a top and bottom bearing to permit of their always being maintained in tension; as the counterweights are heavier than the rail all lost motion is eliminated.

The work table has square locked gibbed bearings on the base, and the drive is by means of an angular rack and spiral pinion; there are nine changes of reversing gear feed, and fast power transmission serves for operating the table for the elevation of the rail, and for imparting reversing feed and fast power traverse to the vertical spindle on the cross rail.

The length of the work table is to mill 7 ft., but this can be made any length to suit requirements, and the dimensions of the machine over all is 9 ft. in length and 11 ft. in width over motor brackets and extending levers. The rack on this table is of steel, and the engaging pinion is of bronze; the motor has a speed of 440 to 1,400 r.p.m., giving spindle speeds to the horizontal spindle of 13.73 and 43.70 r.p.m., and to th vertical spindle 11.11 and 35.61 r.p.m. The feeds of the table per revolution of vertical spindle is .0349 in. and .3615 in., and to the horizontal spindle from .0285 in. to .2945 in. The table feeds per minute range from .3915 in. to 4.05 in. on the slow speed of the motor, and from 1.245 in. to 12.90 in. on the high speed. The quick movement to the table is 66.25 in. on the slow speed and 17 ft. 7 in. on the high speed of the motor. The quick movement per revolution of the horizontal spindle is 4.82 in., and per revolution of vertical spindle is 5.91 in.; the cross feed to the vertical head on rail per revolution is .0392 in. to .406 in., and the down feed to the rail is .0468 in. to .485 in. per revolution of vertical spindle.

Motion for driving the machine is transmitted from the motor mounted on the pad through the new design of General Electric rag pinion to the driving spur gear, a bevel gear transmitting motion to the vertical shaft, also to the horizontal shaft running through the bed for driving the right hand head. This machine will weigh 30,000 lbs. net, and is the last recently shipped to the Australian Railway Commission.

CONTRACTORS ARE RUSHING WORK ON THE NEW UNION STATION in Baltimore, and according to Gamble Latrobe, general agent of the Pennsylvania Railroad in Baltimore, the structure should be completed about April 15. It is expected that the connecting street bridge will not be completed until some time later, but the road has been practically assured by the contractors that the new building will be turned over by the middle of April.

FOR HARDENING HIGH-SPEED TOOLS the barium-chloride process has many advantages. Commercial barium-chloride, to which about 2 per cent. of sodium carbonate has been added, is melted in a graphite crucible and raised to a temperature of from 2,000 to 2,125° F. The tool is kept in the bath until it attains the temperature of the bath, and is then quenched, preferably in an oil-bath.

THE SUPREME COURT OF GEORGIA has rendered a decision sustaining the constitutionality of the state law passed in 1908 requiring the railroads to equip all their locomotives with electric headlights. It was given in a test case, the Atlantic Coast Line having refused to obey the law, and upon conviction of its violation was fined $250.

"THE RULE OF THE ROAD WILL BE TO KEEP TO THE RIGHT," was the order issued by division superintendents of the Lake Shore Railroad from Buffalo to Chicago, which required an expense of $750,000 to make necessary alterations in signals, switches and stations.

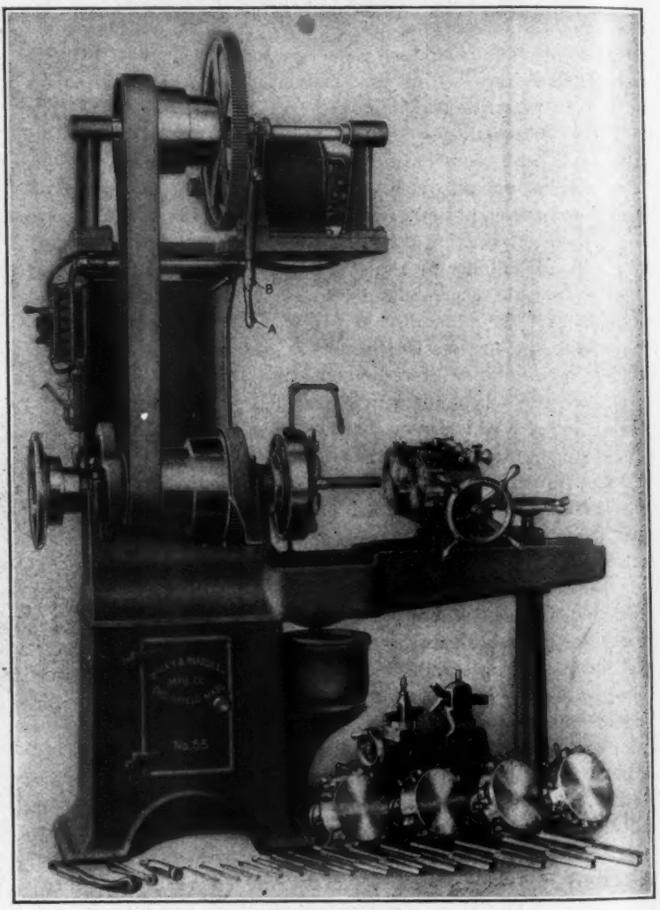
THE SIXTY-THIRD MEETING of the American Society of Mechanical Engineers will be held in Pittsburgh, Pa., from May 30th to June 2nd, inclusive. The Society has not met in that city since 1884.

THE LEHIGH VALLEY RAILROAD has decided upon the policy of applying steel underframes to all freight cars passing through its shops hereafter for general repairs.

MOTOR DRIVEN BOLT CUTTER

A striking example of development in connection with the indispensable bolt cutter is shown in the accompanying illustration which represents the latest output in that line of the Wiley and Russell Mfg. Co of Greenfield, Mass. This machine is something entirely new, and combines the features of an opening-die bolt cutter, nut tapper, pipe-threader and cutting-off machine, with the addition of electric motor drive. The drive is attached to a standard machine and forms the feature of main interest.

In the arrangement of the drive it will be noted that a bracket is fitted and bolted to the bed on which the motor shelf

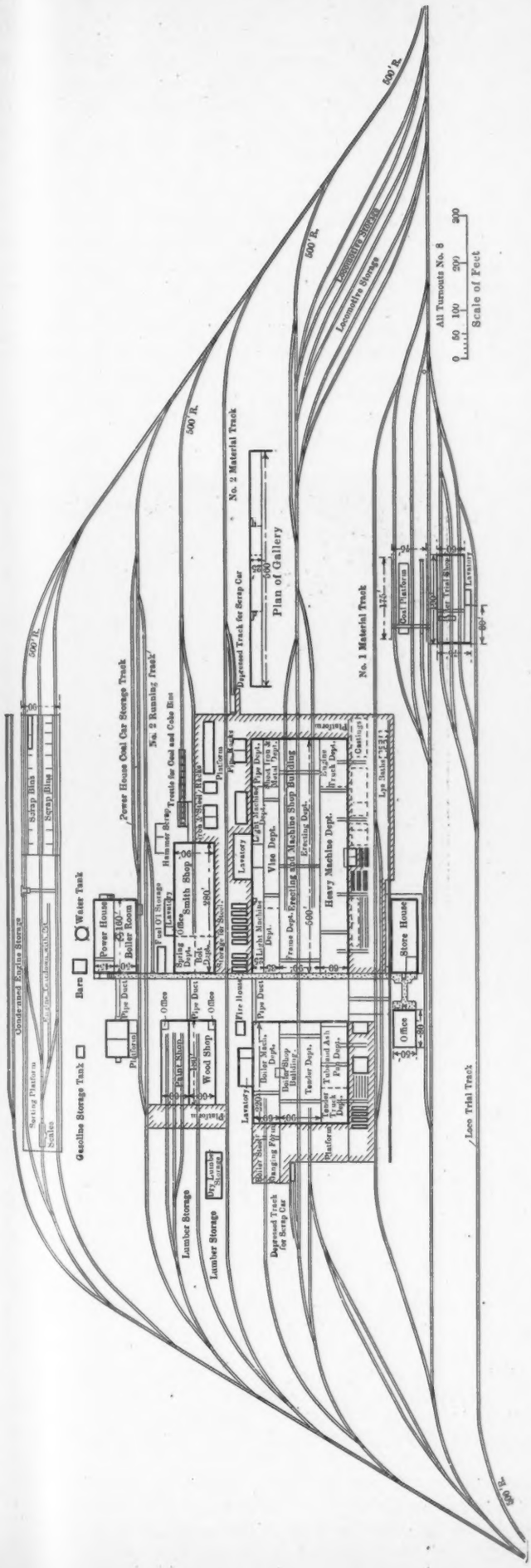


APPLICATION OF MOTOR DRIVE TO BOLT CUTTER.

is secured. This shaft is hinged at the back and has finished projecting lugs which rest on the cam shaft operated by the lever (A). By this sufficient tension can be kept on the belt at all times and the belt can be slackened off when desired to shift it from one step to another on the cone pulley. After the belt is tightened the cam shaft is locked with a binder. The lever (B) in front of the motor controls the clutch in the large spur gear so that the bolt cutter can be stopped independently of the motor. The latter, which is of two horsepower, is constant speed and back geared, and is fitted with a rawhide driving pinion. The motors are furnished for direct or alternating current, reversing or non-reversing.

It is quite apparent from a study of the design that the entire arrangement is strongly and carefully fitted, the machine being guaranteed in fact to cut bolts and pipe to two inches in diameter. The weight of the machine with motor complete is 2,300 pounds.

THE BOSTON & ALBANY already has in successful operation telephone equipment covering the whole of its main line and all branches from Boston to Albany. On these four circuits, extending 390 miles, there are 165 stations.



A GENERAL LAY-OUT FOR A MODERN LOCOMOTIVE REPAIR PLANT

At the January meeting of the New York Railway Club a paper was presented by H. H. Maxfield, master mechanic of the Trenton shops, Pennsylvania Railroad, on the "General Lay-out for a Modern Locomotive Repair Plant," which was listened to attentively and occasioned considerable discussion. The paper outlined an assumed terminal to meet certain conditions, one of sufficient capacity to turn out 75 locomotives per month with general repairs from 25 engine pit spaces.

The general assumptions were first, number of locomotives to be maintained, 750; average weight of locomotives, 80 tons; character of territory served, generally level; character of traffic, mixed—high speed passenger, local passenger, fast freight and slow freight. Under such conditions as set forth by the author, 120 per cent. of the locomotives would pass through the shop for repairs each year, these repairs varying from a new firebox and general repairs to machinery, to repairs such as renewal of broken parts, repairs due to wreck, or heavy running repairs which are not usually attempted in the ordinary roundhouse. These requirements dictated the arrangement of the layout which accompanied the paper and is reproduced herewith.

The following abstracts from the paper were accorded the principal discussion:

The first thing to be determined is whether the erecting shop should be of the longitudinal or cross-type. It is not the intention to enter upon a discussion of the relative merits of the cross and longitudinal erecting shop. The writer has found that, as a rule, the opinion held depends to a great extent upon whether past experience has been with a cross or with a longitudinal shop. I do not like to pass this point, however, without expressing a preference for the longitudinal shop, and passing over the questions of cost, floor space, cranes, etc., give as my reasons:

First, greater flexibility; second, more economical use of track space; and third, greater output from a given amount of track space.

After repairs to a locomotive have been completed it is necessary to fire it up and thoroughly try it out in order to develop minor defects. If a roundhouse is available this work is generally taken care of at that place. In case of the central shop, however, it is possible that the nearest roundhouse is too remote to allow this being done, and furthermore, it may be under different jurisdiction. Assuming the above to be the case, it becomes necessary to provide for this after-trial work at the shop proper. To bring the locomotive back into the erecting shop involves a serious delay to the legitimate work of that department, it being necessary to hold track space in reserve, which prevents bringing other locomotives into the shop, which not only reduces the efficiency of the department, but reduces the earning capacity of the men. Furthermore, the escaping smoke and gases are very objectionable.

The only satisfactory way to handle this after-trial work is to provide a separate building for this purpose, making it an auxiliary to the erecting shop, and under the supervision of that department. This auxiliary shop, or after-trial shop, as I prefer to call it, should be reasonably close to the erecting shop, and yet far enough away to prevent the escaping smoke and gases from flooding the other buildings. It should be adjacent to the track over which incoming engines pass, and also adjacent to the track on which engines are tried. Alongside of this building should be a coal platform and an ash pit. If we locate this building about 200 ft. from the far end of the erecting shop, and about 200 ft. to one side of it on the storehouse track, the various conditions mentioned will be met. The after-trial shop should be rectangular in shape and should have three tracks running through it each track being long enough to accommodate two engines with their tenders. This building should be equipped with wheel pits and an overhead traveling crane.

A considerable portion of the paper is devoted to a consideration of the arrangement, dimensions and floor space of the various buildings included in the proposed lay-out, which, however, are apparent from a study of the drawing herewith. There is nothing extraordinary in connection with the layout as presented, and it is not expected that the sizes of the various buildings given thereon will be correct for all conditions, even assuming that the number of locomotives to be maintained is the same. As explained by Mr. Maxfield the main idea of the paper is to develop a general plan, and he avers that this general plan will fit all conditions up to the point where the number of locomotives to be maintained is so large that any one plant of any design, large enough to handle them, will be unwieldy and therefore inefficient. The layout is, however, sufficiently self-explanatory to readily present the intent of the author. It is quite clear from a casual examination that ample facilities have been provided to take care of the repairs mentioned at the beginning of this review.

Principal interest in the discussion which followed the presentation of the paper centered in a consideration of the relative merits of the transverse or the longitudinal shop, and on the merits of the so-called after-trial shop. Opinion as usual was divided on the first proposition; the transverse arrangement was commended by Mr. Westley, of the Philadelphia and Reading

Ry., and rather severely criticised by Mr. Chambers, of the New Jersey Central R. R. The remaining comment on this question was largely non-committal, but the consensus of opinion, and obviously the correct attitude, is to resort to the one best indicated by conditions.

The question of the after-trial shop proved of much interest to the auditors and the suggestion generally met with much favor. It was believed that locomotives repaired at a central shop should be turned over to the various divisions where they belong ready for service, not ready for trial. Even if a roundhouse is present in connection with the central shop it was agreed that the burden and expense of careless workmanship or unavoidable defects should be upon the shop, and not upon the roundhouse organization. This plan was endorsed by Mr. Flory, of the New York, Ontario and Western Ry., and excepted to by E. O. Elliott on the following grounds:

"I want to take exception to the after-trial shop which has been considered one of the salient points in this paper. I remember a shop where they had an after-trial department and engines which were repaired were standing around for a week or a week and a half afterward, while they were needed in service. This shop was then in its first stages of organization, so finally they did away with the after-trial features, and disciplined the organization so that the engines, when they left the shop, were ready to go into service without much time being spent tinkering on them. Now we feel that the moral effect of having somebody go over the work after it has been completed and fix up the defects is something to be considered. I see the point is made that the after-trial shop would be under the control of the superintendent or master mechanic. Therefore he is responsible in the end. But so long as human nature is human nature, if we have this after-trial shop, those working in the different departments will be anxious to get rid of the work as soon as possible and shove it off on the after-trial shop."

The subject of the after-trial shop is in reality the most important consideration presented in the paper. It is a point which, although it crops up with surprising regularity, still remains undecided, and it is to be regretted that it was not accorded a more extended discussion. On the whole, Mr. Maxfield's paper is to be commended in that it introduced subjects which are of timely interest without mere adherence to the question of a speculative shop layout.

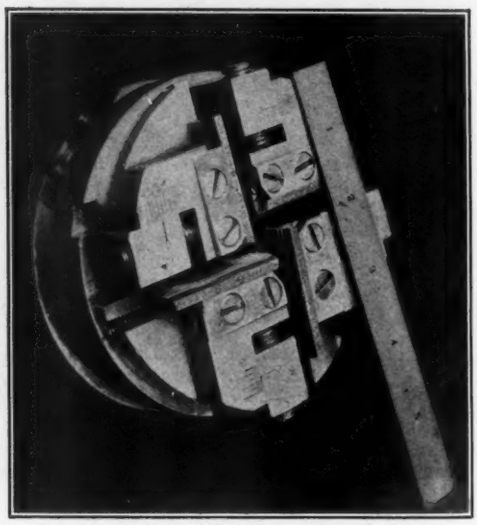
PENNSYLVANIA RAILROAD REDUCES FIRE LOSSES.—The annual report of the Insurance Department of the Pennsylvania Railroad system, recently issued, shows that the company's losses by fire in 1910 were $280,097, as compared to $402,615 in 1909—a reduction of almost a third. In the past few years the Pennsylvania Railroad has redoubled its efforts to prevent fires along its lines. Many corps of employees have been trained in nre fighting, until to-day the company's own organization of firemen extends over the entire system, in every station, roundhouse and shop. In addition, yard locomotives have been equipped for fire fighting service in congested districts. That the company's methods are proving efficacious is indicated by the fact that in 1910 there were 379 fires on the property extinguished with the railroad's fire apparatus and by the company's own employees, with only a loss of about $18,000. In 1909 there were 321 fires extinguished by company apparatus and employees and the loss was approximately $20,000.

RAILWAY ACCIDENTS ABROAD.—A. L. Mohler, vice-president and general manager of the Union Pacific, returning from a tour of Europe, finds occasion to take exceptions to the general belief abroad that there are a great many more train wrecks in this country than there are anywhere in Europe, which he declares is entirely unfounded. In his trip Mr. Mohler discovered that the same conditions of railroading obtain there that are found here, and he believes, personally, that there is an even greater average of accidents.

SOLID ADJUSTABLE DIE HEAD

The Landis Machine Co., of Waynesboro, Pa., has recently brought out a new type of die head known as a "Solid adjustable Die Head." The purpose of this is to take the place of the solid dies now in use on any of the screw machines and other types of machines where the work is backed out of the die after the thread is cut. The die head is illustrated herewith, showing the 1 in standard size which has a range from ¼ to 1 in.

The die head is held in the turret of any ordinary screw machine, and trips off by retarding the forward motion of the carriage. It is also made without the tripping device for special requirements. The tripping arrangement is such that when the desired length of thread is cut, the die head will trip and revolve with the work until the machine has time to reverse. The dies are made from high speed steel and can be ground and re-ground many times, thus giving a life much greater than a solid die, besides never requiring to be annealed, hobbed or retempered, and they are readily adjustable to take up wear in addition to the adjustment for different diameters.



A NEW DIE HEAD.

One set of chasers can readily be set above or below their rated diameter. For instance, ½ inch (13 thread) can be set to cut 1 in. diameter when desired, or they can also be set to cut ¼ in. diameter. The angle in the thread, however, will not be quite ideal, but all that is required for ordinary screw machine work. With other types of die heads a special set of chasers is required every time it is desired to cut other than standard pitches. With this head any diameter within the range of the head can be cut with one set of dies so long as the pitch is the same. In very special cases where absolutely correct pitch is required, it would be advisable to use special holders so as to set the chasers on the exact angle to correspond with the angle of the thread, but ordinarily this is not required. Chasers can at all times be ground to suit the material to be cut; any amount of rake can be given that is necessary, thereby insuring the best possible cutting condition and securing ideal results.

The special advantages with this type of head are that it will admit of very much increased cutting speeds over others, has a life many times that of any other, has a wide range, any one chaser of a set can be adjusted independently of the others, if necessary, and each grinding of the dies gives all the qualities of a new die. Any chaser of a set can be replaced without replacing the complete set. By using this die very high cutting speeds are readily acquired, equal to the turning and drilling speeds on the other operations of the screw machine, so that the speeds need not be reduced in the threading operation for the accommodation of the die, as is the case with the solid dies.

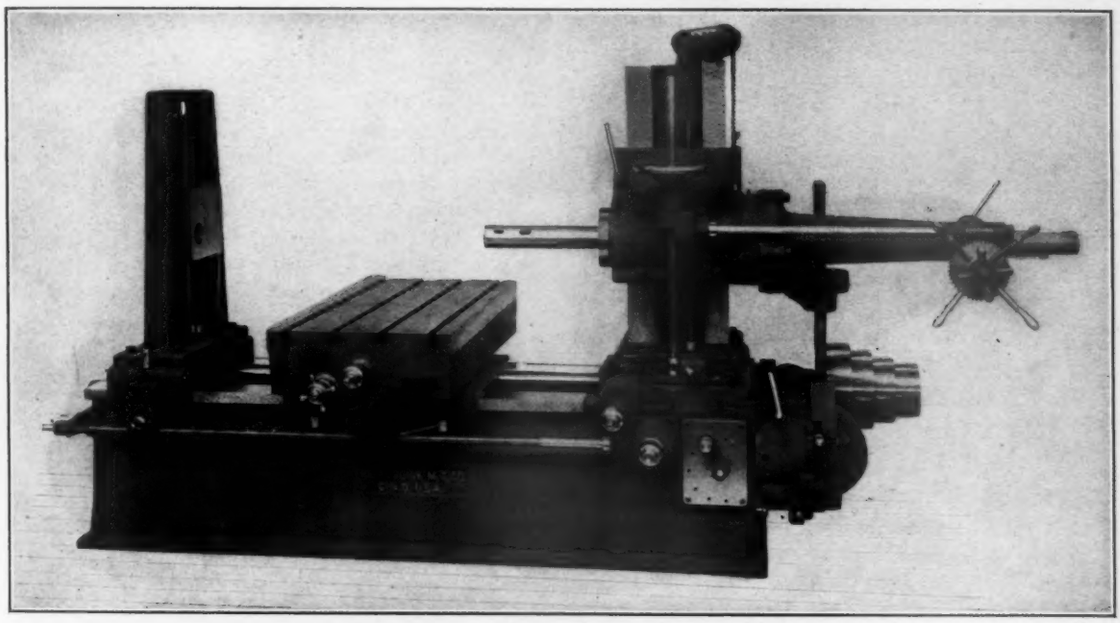
HORIZONTAL BORING, DRILLING AND MILLING MACHINE FOR WIDE RANGE OF WORK

In the design of this machine the Fosdick Machine Tool Company has embodied several features of interest, such as a deep bed of great rigidity, which makes the machine self-contained and a foundation unnecessary, and insures perfect alignment of the table with the spindle and outer support at all times. All the gears are of steel, of heavy pitch; all bearings are large and bronze bushed, and all moving parts are covered. A mere cursory examination of the design creates at once the impression of unusual strength combined with a compactness seldom observed in connection with this particular tool. It is especially adapted for hard service under varying conditions, and appears to be particularly suitable for the requirements of railroad machine shops in general, where a boring mill of larger dimensions would be unnecessary.

The drive in this machine is either through the cone or speed box. A four step cone pulley is used, the largest step of which is 14 in. by 3¼ in., permitting the use of a 3 in belt. The speed box is provided with eight changes of speed, all instantly available. Both cone and speed box drives can be started and stopped from the front of the machine by a conveniently located lever. The machine can be reversed by the use of a reversible countershaft. The spindle head on outer support for the boring bar are raised and lowered simultaneously by power or hand. It is fitted with an automatic safety trip to prevent any accident due to carelessness. The spindle is of crucible steel, accurately ground, and is fitted with a Morse taper. It passes through a soft iron sleeve and is driven by a large key. The thrust is taken up on ball bearings.

The sleeve runs in bronze bearings and carries the driving gear. It is equipped by a device whereby the spindle can be kept in line after any amount of wear. The front of the sleeve forms a face plate to which milling cutters, facing heads or other tools may be attached, thereby relieving the spindle bar to a large extent, and also eliminating chattering when using large milling cutters. The table is of heavy construction, has T slots planed in it, and is scraped absolutely square with a line passing through the center of the spindle. An automatic safety stop is provided here also to prevent breakage due to the carelessness of the operator. It has a longitudinal motion by hand and a cross motion by hand or power. There are eight changes of feed, all reversible, which are obtained through one box.

Adjustment of the spindle head, platen and outer supports is made by screws accurately spaced. The ends are provided with micrometer collars, graduated to .001 in., making it possible to bore, drill and mill surfaces to exact distances apart without the use of jigs, which makes it an invaluable machine for the tool room or wherever great accuracy is required. The workmanship and material are the best obtainable, and are guaranteed throughout. The floor space is 13 ft. 8 in. and the approximate net weight is 7,700 lbs.



POWERFUL HORIZONTAL BORING, DRILLING AND MILLING MACHINE.

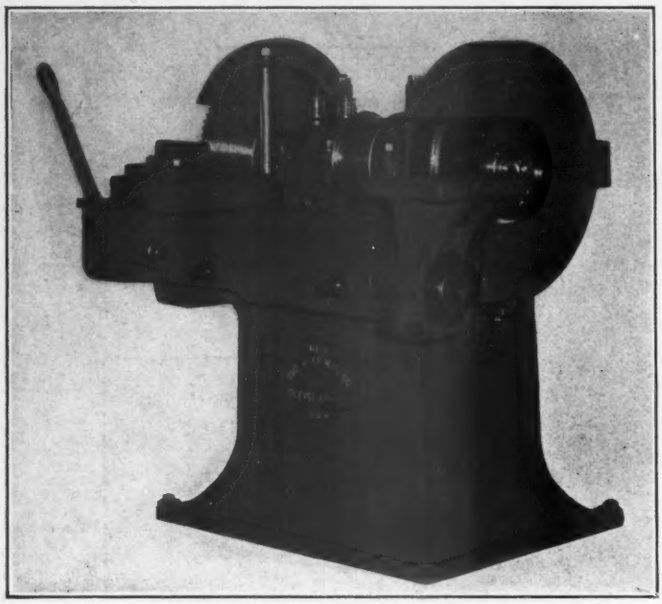
THE PENNSYLVANIA'S RELIEF FUND SYSTEM

More than two and one-quarter million dollars in benefits were distributed during the year 1910 to members of the Relief Funds of the Pennsylvania Railroad System, according to a report recently issued by the company. The membership of the Funds on December 31st, 1910, was 162,052, or nearly 85 per cent. of the total number of employes in the service. Some idea of the extent of the work of the relief departments can be had from the fact that during the past year payments to the families of members who died amounted to $839,750.87, while $1,449,967.42 was paid to members who were unable to work. Since the Relief Funds for both the Lines East and West of Pittsburgh were established some 25 years ago, $11,949,213.01 has been paid to the families of members who died, and $17,814,217.49 to members unable to work, or a total distribution to December 31st, 1910, of $29,763,430.50.

The report recently issued shows that during the month of December alone the sum of $192,124.73 was distributed to members of the Pennsylvania Relief Funds who had become incapacitated for work on account of sickness or accident, and to the families of members who died. In December, on the Lines East of Pittsburgh and Erie, the payments in benefits to the families of members who died amounted to $61,408.03, while to members incapacitated for work they amounted to $78,640.95. The total payments on Lines East of Pittsburgh since the Relief Fund was established in 1886 have amounted to $21,644,748.84. The Relief Fund of the Pennsylvania Lines West of Pittsburgh paid during December a total of $52,075.75, of which $12,937.50 were for the families of members who died, and $39,138.25 for members unable to work. The sum of $8,118,681.66 represents the total payments of the Relief Fund of the Pennsylvania Lines West of Pittsburgh since it was established in 1889.

HOT SAW AND BURRING MACHINE

One of the most interesting and useful machines recently placed on the market for the forge shop equipment is a hot saw and burring machine manufactured by the Ajax Mfg. Co., Cleveland, Ohio. This machine has been designed and is intended primarily for service in connection with an upsetting forging



THE AJAX HOT METAL SAW.

machine, a complete line of which machines the same company manufactures, and the designing and marketing of this machine has been prompted by the desire of the manufacturer to further economize in the production of machine-made forgings By the use of a hot saw and burring machine the headed forging may be sawed off the bar immediately after it is upset, thus leaving a clean, square end, and likewise the burrs or fins which are formed after a set of dies have been used, can be removed very readily.

The machine as shown in the illustration herewith is similar in general design to a double ended grinding or emery wheel stand. On one end of the shaft is a head fitted with a milled band and a milled disc face. This end is used for removing the fins or burrs from the upset forgings. The opposite end of the shaft carries a hot saw for cutting off the forging from the bar. These machines are built in three sizes, with 14-in., 20-in. and 30-in. diameter of saws and burring heads. They operate at a high rate of speed and are consequently built rigidly with large bearings and ample provision for lubrication. The utility of such a machine will be fully appreciated by users of upsetting forging machinery.

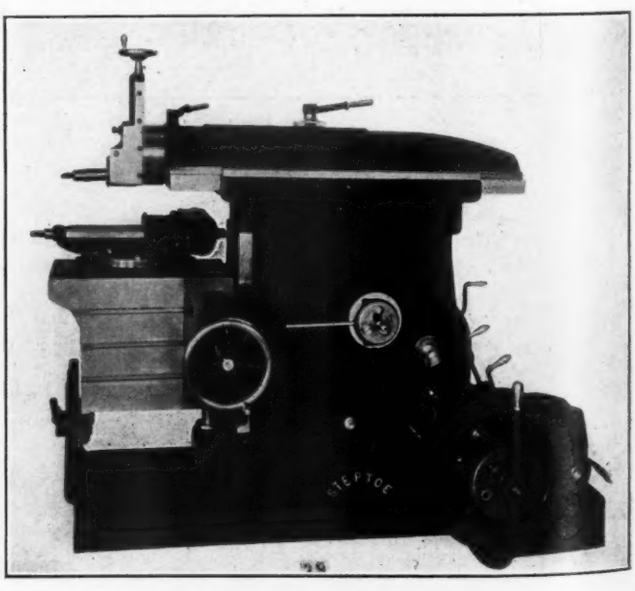
REMARKABLE RECORD ON HARRIMAN LINES.—The Harriman lines carried 10 per cent. of the estimated 1910 passenger traffic of the United States, or 49,491,000 people, without fatal accident to any of the number. The report, containing this data, just has been compiled in the offices of the director of maintenance and operation, and covers the total system of some 17,960 miles. The total number of passengers carried on a one-mile basis was 3,000,000,000. The figures of the country's railroads for 1910 have not yet been compiled by the government, but in 1909 the Interstate Commerce Commission reported the number of passengers carried as 29,000,000,000. In the year 1903-1904 the number of accidents on the Union Pacific was 20 for 1,000,000 locomotive miles. In the final half of 1910 it was only .4 for 1,000,000 locomotive miles. On the Pacific system of the Southern Pacific the number of accidents per 1,000,000 locomotive miles was reduced in the same time from 20.5 to 10.5.

BACK GEARED CRANK SHAPER WITH MOTOR DRIVE AND SPEED BOX

This handsome and substantial tool is the latest production of the John Steptoe Shaper Co., of Cincinnati, O., and it embodies several distinctive features which entitle the design to a careful study. In particular the drive, which is very simple, consisting of a small gear on the motor with a large gear on the speed box shaft, is of particular interest. The motor is set on a sub-base, cast on the base of the shaper, and therefore rests on a very solid foundation, and avoids the possibility of shaking the machine when running.

Four changes of speed are secured through the speed box, and by means of the back gears eight changes are secured. The speed box is so arranged that no clutches are used, and therefore no gears run idle on the shaft. When one gear is shifted in position, the other is shifted out, thereby making a very effective drive and reducing the wear to a minimum. All the bearings in the speed box are equipped with ring oilers which keep the shafts constantly flooded in oil. Spiral oil channels are chased in the shaft to insure the proper distribution of the oil over the entire bearing. A large bush is provided where the driving shaft from the shaper enters the speed box. This bush enters the column of the shaper and also the speed box bearing. The driving shaft is therefore relieved of any possible strain that might come from the speed box, as such strain would come directly on the bush provided for that purpose. This bushing is equipped with ring oilers, both in the column of the shaper and in the speed box. The intermediate shaft in the shaper is also provided with ring oilers and bushings which can be readily removed and replaced at any time should it become necessary.

The machine can be stopped or started by means of a clutch which operates in the hub of the large gear. One pound pressure on the clutch lever gives 128 pounds pressure on the ring, so that the starting operation can be effected by an almost imperceptible effort. It is advanced, in fact, that this can be effected by means of the thumb and first finger of the right



NEW STEPTOE SHAPER.

hand. All of the clutch mechanism is fully enclosed, thus avoiding any possibility of accident to the operator.

It is clearly apparent, from a study of this machine, that the drive, irrespective of other points of superior merit, is so simply constructed that there is in reality nothing pertaining to it which could become out of order. It is a sensible and practical machine throughout, and fully maintains the reputation of its builders.

The Railroad Clubs

CLUB	NEXT MEETING	TITLE OF PAPER	AUTHOR	SECRETARY	ADDRESS
Canadian	Mar. 7	Railway Signalling	L. R. Clausen	Jas. Powell	P. O. Box 7, St. Lambert, near Montreal
Central	Mar. 10	Influence of Gravity on Trains Descending Grades and the Power Necessary for Safe Control	J. P. Kelly	A. D. Vought	95 Liberty St., New York
New England	Mar. 14	Revision of Rules of Interchange		Geo. H. Frazier	10 Oliver St., Boston, Mass.
New York	Mar. 17	Seventh Annual Electrical Night		A. D. Vought	95 Liberty St., New York
Pittsburg	Mar. 24	Revision of Rules of Interchange	Committee Report	C. W. Alliman	P. & L. E. R. R., Gen. Office, Pittsburgh, Pa.
Richmond	Mar. 10	.....	Maj. Geo. Hine	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Mar. 10	Not announced	Col. R. V. Taylor	B. W. Frauenthal	Union Sta., St. Louis, Mo.
Western	Mar. 21	Electrification of Chicago Terminals	C. A. Seley	Jos. W. Taylor	390 Old Colony Bldg Chicago
Western Canada	Mar. 13	Should a Railroad Have a Trouble Department?		W. H. Rosevear	100 Chestnut St., Winnipeg, Man.

STANDARDIZATION OF CHILLED IRON CAR WHEELS.

WESTERN RAILWAY CLUB.

W. S. Killam presented one of the most valuable papers that has been read before any of the clubs this year, at the January meeting of the Western. This paper is too important to be reviewed in the space permitted here and is therefore reprinted in abstract in another part of this issue.

TRANSPORTATION OF DANGEROUS ARTICLES.

NEW ENGLAND RAILROAD CLUB.

At the January meeting Col. B. W. Dunn, chief inspector of the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles, presented practically the same paper he has read before many other railway clubs during the past year on this most important and interesting subject. It was fully illustrated with lantern slides.

APPRENTICESHIP.

WESTERN CANADA RAILWAY CLUB.

At the January meeting it was decided that Mr. Gower's paper on "Apprenticeship," which had been presented at a previous meeting, should not be allowed to go without further efforts on the part of the club to put the ideas suggested into operation, and it was decided to appoint a committee who should interview the managements of the various railroads in that district to see if some action could not be taken by these roads to further the modern ideas of apprenticeship training. The committee appointed consisted of the following gentlemen: S. J. Hungerford, W. E. Woodhouse, A. H. Eager, G. W. Robb and T. G. Armstrong.

S. A. Gidlow, general secretary of the St. Johns Ambulance Association, Canadian Pacific Railroad, presented a paper on "First Aid to the Injured." This paper pointed out the value of first aid knowledge in all conditions of existence—particularly in hazardous occupations, around shops, etc. It explained the course of lectures, giving a syllabus, that are given to the classes now being organized among all classes of employees throughout the Canadian Pacific Railroad System. These classes are very carefully conducted and examinations are given to assure a correct understanding of the work. There are now 51 classes, consisting of 1,607 men, in operation on the various divisions.

This paper aroused a most interesting discussion and many points of interest and value were brought out.

GENERATION AND DISTRIBUTION OF ELECTRIC POWER AND ITS APPLICATION TO RAILROADS.

CANADIAN RAILWAY CLUB.

F. Darlington, chief engineer of the Railway Department of the Westinghouse Electric & Manufacturing Co., at the February meeting of this club presented a most interesting and instructive paper on the application of electricity to railroad service. In a very clear manner he pointed out the predominating importance of the load-factor of the power station on the unit cost of output. Assuming that the power plant is used exclusively for transportation purposes the power factor must of necessity be very low unless a tremendously expensive storage battery equipment is installed, as has been done by the New York Central Lines. Costs of current at the switchboard under various assumed conditions were given to illustrate this feature.

The impression gained from a reading of this paper is that Mr. Darlington does not favor the electric operation of railroads in general unless other features than economy are the controlling ones. This idea is based on the poor load factor and does not hold if it is possible to either purchase current from an outside source or to have sufficient uses outside of transportation for current from a central power station to give it a satisfactory load factor. This in many cases can be done with not only direct economy on the transportation costs, but also an improvement on the manufacturing conditions in the neighborhood.

THE EFFICIENCY OF TOOLS AND ECONOMY IN MANUFACTURING THEM.

CANADIAN RAILWAY CLUB.

W. M. Townsend, supervisor of tools, Montreal Locomotive Co., presented a very valuable paper at the January meeting of this club on the manufacture of tools. The subject of milling cutters was first considered in detail and the best design and proper method of handling in the manufacture were very clearly indicated. It was stated that cutters having a diameter much less than 6 in. should not have inserted teeth, but above that size inserted teeth were often advisable. The cost of the different kinds of steel suitable for this use was discussed, as well as the proper size and shape. Next the author considered the regular list of tools used on lathes, planers, etc., and stated that a great saving can be made by using a piece of billet steel for the body of the tool and welding a tip of high speed steel at the cutting edge. The methods of doing this were very clearly explained in detail. Drills were then considered in much the same manner as were also reamers. Attention was drawn to the importance of having an accurate distribution of tools in order to obtain the greatest economy. This should be under the control of a specialist who also is the expert on tool design and manufacture, and should not be left to the tool room foreman, whose duties prevent him from properly following up the use and abuse of the various tools issued.

THE JACOBS-SCHUPERT UNITED STATES FIRE BOX COMPANY, Coatesville, Pa., has applied for a charter under Pennsylvania laws. Those interested are A. F. Huston, Charles L. Huston and Joseph Humpton of the Lukens Iron & Steel Company, together ith a number of officials of the Atchison, Topeka & Santa Fé Railroad. The company controls the patents and has erected and equipped a plant at Coatesville for the manufacture of the Jacobs-Schupert fire boxes for locomotives, invented by Henry W. Jacobs, assistant superintendent of motive power of the Santa Fé Railroad, and Frank W. Schupert.—*Iron Age.*

PERSONALS

HARRY D. BISHOP has been made roundhouse foreman at Belen, N. M., vice C. C. Brooks.

C. M. WHITNEY has been made general foreman of the 'Frisco shops at Cape Girardeau, Mo.

C. C. SHEPHERDSON has been appointed assistant foreman of the Santa Fe at Albuquerque, N. M.

L. L. COLLIER has been appointed foreman of the Santa Fe at Ashfork, Ariz., vice J. Williams, resigned.

H. S. LLOYD has been made master mechanic of the Tennessee, Alabama & Georgia R. R., at Alton Park, Tenn.

GEORGE SPRATLEY has been made master boilermaker of the Colorado Midland R. R. at Colorado City, Colo.

W. C. RADKE has been appointed master mechanic of the Northern Pacific R. R., with headquarters at Staples, Minn.

E. L. RICHARDSON has beeen appointed general foreman of the Norfolk and Western Ry., with office at Roanoke, Va.

CHARLES MANLEY has been appointed superintendent of shops of the National Railways of Mexico, with office at Aguas Calientes.

D. L. RINGLER has been made roundhouse foreman of the Trinity and Brazos Valley Ry. at Teague, Texas, vice E. L. Critz, transferred.

J. B. KILPATRICK has been made superintendent of motive power of the first district of the Rock Island system, with office at Chicago.

S. W. MULLINIX has been made superintendent of motive power of the second district of the Rock Island system, with office at Topeka, Kans.

C. M. TAYLOR has been made superintendent of motive power of the third district of the Rock Island system, with office at Shawnee, Okla.

C. A. WOOD succeeds C. W. Tessier as general foreman of the car department, National Railways of Mexico, with office at Aguas Calientes.

J. E. HENSHAW has been made superintendent of the St. Louis & San Francisco Ry. shops at Springfield, Mo., succeeding T. W. Lillie, resigned.

T. M. PRICE has been made superintendent of the shops of the Detroit, Toledo & Ironton at Jackson, Ohio, vice H. F. Martyr, resigned as general foreman.

V. W. ELLET has beeen appointed a general foreman of the Rock Island Lines, with office at Rock Island, Ill., succeeding J. E. Loy, assigned to other duties.

E. T. MILLER, general foreman of the Concord shops of the Boston & Maine R. R., has been appointed general car inspector with office at Boston, Mass.

G. S. HUNTER has been appointed a master mechanic of the Missouri, Oklahoma & Gulf R. R., with office at Muskogee, Okla., succeeding J. F. Grealy, resigned.

J. W. SMALL, superintendent of machinery of the Kansas City Southern R. R., at Pittsburg, Kans., has had his authority extended over the Arkansas Western R. R.

W. J. TOLLERTON has been appointed assistant general superintendent of motive power of the Chicago, Rock Island and Pacific Ry., with headquarters at Chicago.

N. S. BROOKS, general foreman of the Baltimore and Ohio R. R. at Keyser, W. Va., has been appointed assistant master mechanic, with office at Cumberland, Md.

E. O. ROLLINGS, assistant master mechanic of the Louisville and Nashville Ry. at Howell, Ind., has been promoted to be master mechanic, with office at So. Louisville, Ky.

T. M. PRICE, assistant master mechanic of the Detroit, Toledo & Ironton Ry., at Jackson, Ohio, has been appointed general foreman, with office at Jackson, succeeding H. F. Martyre, resigned.

W. G. TAWSE, road foreman of engines of the Chicago & Eastern Illinois R. R., has resigned that position and is now with the Locomotive Superheater Company, New York, with office at Chicago.

WILLIAM P. CARROLL, terminal foreman of the New York Central & Hudson River R. R., at Buffalo, N. Y., has been appointed master mechanic, with office at Rochester, succeeding F. M. Steele, resigned.

M. WEBER has been appointed master mechanic of the Albuquerque division of the Atchison, Topeka & Santa Fe Coast Lines, with office at Winslow, Ariz., succeeding William Daze, assigned to other duties.

W. G. HAMMELL, formerly chief engineer, has beeen appointed purchasing agent of the Atlanta, Birmingham and Atlantic R. R. He relieves W. D. Knott, who has been given leave of absence on account of ill health.

O. T. HARROUN has resigned as tool foreman of the Chicago & Alton R. R. and the office is abolished. Mr. Harroun is secretary of the American Railway Tool Foremen's Association, and is temporarily located at Odin, Ill.

O. S. JACKSON, master mechanic of the Chicago, Indianapolis & Louisville Ry., at Lafayette, Ind., has been appointed superintendent of motive power of the Chicago, Terre Haute & Southeastern, with office at Terre Haute, Ind.

G. L. LAMBETH, master mechanic of the St. Louis division of the Mobile & Ohio R. R., at Jackson, Tenn., has been appointed master mechanic of the Mobile division, with office at Whistler, Ala., succeeding E. G. Brooks, assigned to other duties.

J. P. MCCUEN, formerly superintendent of motive power of the Cincinnati, New Orleans & Texas Pacific Ry., and who retired recently after 30 years of service, will be retained with the road in an advisory capacity, with the title of general inspector.

JNO. A. CLARKE, of the purchasing department of the Canadian Pacific Ry. at Montreal, died on Feb. 5, aged 63 years. Death ensued from hemorrhage of the brain brought on by a fall sustained while in attendance at the funeral of the late chief engineer of the road, J. E. Schwitzer.

C. W. DIEMAN has beeen appointed master mechanic of the Green Bay & Western Ry., the Kewaunee, Green Bay & Western R. R., the Ahnapee & Western Ry. and the Iola & Northern R. R., with office at Green Bay, Wis., succeeding W. P. Raidler, resigned to engage in other business.

F. O. WALSH, master mechanic of the Atlanta & West Point R. R. and the Western Railway of Alabama, at Montgomery, Ala., has been appointed mechanical assistant to the general manager of the Brazil Railroad Company, in charge of the mechanical department, with office at Sao Paulo, Brazil, S. A.

J. W. MARDEN, superintendent of the car department of the Boston & Maine R. R., has resigned after fifty years of continuous service. The above position which Mr. Marden held since 1907, is now abolished, and the business of that department will come under the supervision of H. Bartlett, general mechanical superintendent.

WILLARD DOUD, shop engineer of the Chicago, Burlington and Quincy R. R., resigned from that position February 1, and has beeen appointed in a similar capacity on the Illinois Central R. R. Mr. Doud will give his particular attention to planning improvements in power plants, and other features of shops which come especially under the mechanical department.

GEORGE PARSONS SWEELEY, late master mechanic Allegheny shops, Pennsylavania lines, Northwest system, who died at his home in Allegheny on January 10, 1911, was very well known in mechanical circles and has been in continuous service with the Pennsylvania for more than thirty-five years. Mr. Sweeley was born in Montoursville, Pa., on July 18, 1856. He was a member of the M. M. and M. C. B. associations, the Pittsburg Railway Club, the Bellevue Club and the Masonic fraternity.

CATALOGS

VALVES.—The Nelson Valve Co., of Philadelphia, Pa., has issued a large folding leaflet illustrating and describing its various globe, angle, gate and check valves, and which contains much valuable information for users of these parts.

BALL BEARINGS.—The Hess-Bright Mfg. Co., of Philadelphia, Pa., has isssued two leaflets on magneto bearings and centrifugal basket mountings, which retain the attractive appearance so characteristic of the literature issued by this company.

LATHE EFFICIENCY.—This is the title of a very instructive catalog just issued by the American Tool Works Co., of Cincinnati, O. It deals with the facts about engine lathes and illustrates several of the prominent designs of the latter as manufactured by this company.

CONDUIT PRODUCTS.—In catalog 436 the Sprague Electric Co., of New York, presents a variety of illustrated descriptive matter in connection with its conduit products which in the form compiled becomes exceedingly valuable as a reference book for those interested in this line. The catalog, which contains 42 pages, is conveniently divided into sections, and is carefully indexed.

WIRES AND CABLES.—A very handsome catalog, entitled Bulletin No. 4787, has recently beeen issued by the General Electric Co., devoted to the subject of wires and cables. The publication should be of considerable service to purchasing agents, central station managers, and all having occasion to buy or use wire and cable for any service. The book contains much data, but no prices.

POWER AND LIGHTING TRANSFORMERS.—In Bulletin 451, issued by the Triumph Electric Co., of Cincinnati, O., will be found a complete description of the "Triumph Type L" transformers, and the many points of superiority which they possess are specially featured. The bulletin is well written and the various points in the description are presented in a manner which renders them particularly interested.

STEEL PLATE AND MANUFACTURED SHAPES.—The Carnegie Steel Co., of Newark, N. J., has just issued its Waverly Warehouses Stock List No. 6 which is complete with the usual information in regard to the available stock of the Carnegie Company. The pamphlet contains a very attractive map of Waverly, N. J., which graphically illustrates the enviable location of the plant in relation to its railroad facilities.

TOOL ROOM FURNACES.—Bulletin "R," recently issued by the Rockwell Furnace Co. of New York, describes a gas furnace for tool room use which is of decided interest. It in reality embodies eight furnaces in one and is thoroughly adapted for accurately heat treating small tools, etc., and for annealing, hardening, tempering and forging. This is a most compact and complete furnace and is well designated as a necessary, if not an indispensable, accessory to an up-to-date tool room.

BRAKE BEAMS.—The Chicago Railway Equipment Co. has recently issued under the title "The Railway Equipment Primer," a novel presentation of the merits of the Creco brake beam. This little book is strongly reminiscent of our old school day companions, the "Rollo Books," and its compiler, Bruce V. Crandall, has in happy vein brought some compelling points home to us. Notwithstanding its gloss of humor, however, there is a prominent truth embodied in the little book, and as the perusal of its pages progresses it becomes apparent in a way which is quite appealing. Railroad men should read this primer, and if their interest equals our own they will be well repaid.

STORAGE BATTERIES.—This attractive catalog is published in the interests of the Edison Storage Battery Co., and for the purpose of disseminating complete and useful information in regard to the new Edison storage battery. It is intended that it shall answer satisfactorily not only the questions of the novice, but of the man who knows batteries, and who is familiar with the electric vehicle. It deals principally with comparison betweeen the Edison battery and those of the older types, and without referring by name to any particular make of lead battery, all of the comparisons referred to in the catalog are based upon actual experience, and all statements may be easily verified by any competent and honest expert.

ELECTRIC SUPPLIES.—Bulletin No. 4813, just issued by the General Electric Co., describes an oil break switch adapted to use on alternating current series arc systems for sectionalizing feeder systems, cutting in and out transformers, and similar classes of service requiring a switch to be operated under load. Bulletin 4811 contains descriptive matter and data in considerable detail on drum controllers for industrial service, and supersedes the General Electric Co.'s previous bulletin on this subject. Bulletin No. 4791 describes the General Electric regulators of the induction type and switch type, single and polyphase, hand operated and automatically operated. It contains connection and dimension diagrams, together with weights of the various regulators described.

ELECTRICAL CATECHISM—DIRECT CURRENT APPARATUS.—Fairbanks, Morse & Co., Chicago, have published a very interesting booklet giving, in simple language, definitions for electrical terms and describing the construction and uses of different electrical machines. As the title indicates, this treatise is prepared in the form of a series of questions and answers. It was originally prepared for the use of salesmen only, but there has been a considerable demand for it by others. The booklet is well illustrated and printed on enameled paper. The insight which it gives to the products of Fairbanks, Morse & Co. makes it very interesting to engineers, and, to one who is not familiar with electrical machinery, this pamphlet will be of great assistance. It will be sent on request to interested parties.

TOOL STEELS.—An artistic catalog which has been recently issued by Edgar Allen & Co., Ltd., of Sheffield, is devoted to a considerable discussion of high speed steels and their application to the usual and unusual processes wherein employed. The catalog, in addition to specific information in regard to shapes and sizes of tool steel, deals somewhat exhaustively with other products of the company. It graphically illustrates all kinds of steel castings for locomotives, and the important features in connection with the Edgar Allen & Co.'s output; rails, railway crossings and switch layouts are not by any means neglected. The catalog will invite an attentive perusal, and although the company will be pleased to supplement the information if required, its completeness is such that little more can be offered.

TELEPHONE TRAIN DISPATCHING.—Bulletin No. 501, just issued by the United States Electric Co., of New York and Chicago, is designed to present accurate information in respect to the application of selective calling to railway service, and in particular to the use of the Selector Telephone System in train dispatching. The bulletin describes the development of the system and explains fully the functions and service of the Gill selector and the answer-back. The circuits and the outfits for calling with the local battery bell and the main line bell are described and illustrated and some facts regarding the economic advantages of substituting selective telephone train dispatching for the telegraph sounder call are convincingly assembled. The selector outfits to operate under the various optional arrangements are conveniently grouped, as to equipment, and designated by code numbers.

CRANES.—The Whiting Foundry and Equipment Co., of Harvey, Ill., under the title "Cranes of All Types—for Every Service," has issued a 40-page catalog which in condensed form gives a description of special features of Whiting cranes, also views of installations and list of principal customers. The intent of the catalog is to convey that there is a Whiting crane for every service and this is well borne out in the profusely illustrated matter which is a prominent feature. The great diversity in operations which are permissible are presented in a manner which endows it with particular interest. A considerable portion of the catalog is devoted to a detailed description of the component parts. The Whiting Company will be pleased to furnish a copy of the catalog on request and it will well repay a perusal by anyone interested in the subject.

LOCOMOTIVE SAFETY VALVES.—The Crosby Steam Gage and Valve Co., of Boston, Mass., has recently issued a most valuable and instructive little treatise under the title "The Measurement of Steam Discharge in Locomotive Pop Safety Valves." The book is a report of such tests as conducted in April and June, 1910, by Professor Edward F. Miller at the Massachusetts Institute of Technology to determine definitely the two important questions, "How much steam will a safety valve discharge?" and "How much will it relieve a boiler?" The report will repay careful study and analysis. For those who may have a special interest in the subject a discussion of the work is appended showing its practical application in railroad work and its value to the mechanical engineer and superintendent of motive power. The Crosby Company also issues an attractive pamphlet on the Crosby principle in safety valves for locomotives which is fully and clearly descriptive of its locomotive safety valve.

NOTES

F. W. MILLER HEATING CO.—On March 1, 1911, this company assumed occupancy of its new suite of offices 314-315 McCormick Bldg., 108 Michigan Boulevard corner Van Buren St., Chicago, Ill.

PRESSED STEEL CAR CO.—At the regular quarterly meeeting of the board of directors of this company, held January 25, 1911, O. C. Yayley was elected a director to fill the vacancy caused by the recent death of one of the members of the board.

JOSEPH DIXON CRUCIBLE CO.—During 1910 this company of Jersey City, N. J., supplied graphite and graphite lubricants to 210 different steam railroad companies. Its business with the steam railroads increased 58 per cent., and during the same period it sold the same products to 91 automobile manufacturers, increasing its business with them 260 per cent.

BURTON W. MUDGE & CO.—This company, of Chicago, Ill., have added materially to their well equipped organization by electing Thomas A. Garland a vice-president. The attention of Mr. Garland will be directed to the development of car ventilating and refrigerating devices, patented by him while superintendent of refrigerator service of the Burlington system.

WELLS BROTHERS CO.—Announcement is made by the above company of Greenfield, Mass., that Edward Blake, Jr., who has been manager of sales for the past four years, and a director of the corporation, has severed his connection with the company, effective February 1st. Mr. Blake has obtained the controlling interest in the Canadian Tap & Die Company, Ltd., Galt, Ontario, Canada, of which he has been treasurer since its organization in 1905. He leaves within a few weeks to take the active management of the company's affairs and will devote his entire time to promoting its business. He has a wide acquaintance in the machinery and tool trade and among the hardware jobbers; and his many friends, while regretting his departure from among them, will wish him a full measure of success in his new field.

LINDE AIR PRODUCTS CO.—This company of Buffalo, N. Y., has recently increased its capital from $500,000 to $1,000,000. The company has purchased sites at South Elizabeth, N. J., and North Trafford, Pa., and is proceeding at once with the erection of two large factories. It is anticipated that these two new plans will be completed and in operation by June of this year. The contracts for the buildings have been let as well as for such equipment as the company do not themselves construct in their Buffalo shops. The Linde Air Products Company already have two plants in operation—one in Buffalo and one in East Chicago—but the demand for compressed oxygen and apparatus for oxy-acetylene welding has developed during the past twelve months with such unprecedented rapidity that these additional oxygen plants are required to enable the company to keep pace with the demand.

FOR YOUR CARD INDEX

Some of the more important articles in this issue arranged for clipping and insertion in a card index. Extra copies of this page will be furnished to subscribers only for eight cents in stamps.

Apprenticeship AMER. ENG., 1911, p. 105 (March).

FOURTH ANNUAL CONFERENCE OF APPRENTICE INSTRUCTORS ON THE NEW YORK CENTRAL LINES.

Report of the proceedings at the 1911 conference held at New York on January 27.

Car—Private AMER. ENG., 1911, p. 93 (March).

Illustrated description of private car built in England for the South Manchuria Railway, that employs much heavier construction and more commodious arrangements than is customary on foreign roads.

Cars—Wheels AMER. ENG., 1911, p. 108 (March).

Liberal abstracts from a paper on standardization of chilled iron car wheels presented by W. S. Killam before the Western Railway Club.

Locomotives—2-6-6-2 Type AMER. ENG., 1911, p. 90 (March).

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

Illustrated description of locomotive design from which the American Locomotive Co. built 25 engines. Boiler design similar to C. & O. locomotives of same type. The double flexible exhaust pipe and double exhaust nozzle is fully illustrated and described.

Locomotives—2-6-6-2 Type AMER. ENG., 1911, p. 102 (March).

ATCHISON, TOPEKA & SANTA FE RAILWAY.

Fully illustrated description of the first examples of Mallet locomotives with articulated boilers. Two different types of joints are illustrated.

Locomotive Details—Rods AMER. ENG., 1911, p. 99 (March).

MAIN ROD WITHOUT STRAPS OR BOLTS.

Illustrated description of new design of main rod, which does not require the use of straps.

Machine Tools—Bolt Cutter

AMER. ENG., 1911, p. 112 (March).

Illustrated description of a new model bolt cutter employing an opening die type of machine arranged for motor drive in a very satisfactory manner. Designed by Wiley & Russell, Greenfield, Mass.

Machine Tools—Horizontal Boring Machine

AMER. ENG., 1911, p. 115 (March).

Illustrated description of a powerful horizontal boring machine for general work. Designed by the Fosdick Machine Tool Co.

Machine Tools—Lathes AMER. ENG., 1911, p. 107 (March).

Illustrated description of some very powerful high duty machines recently designed by the American Tool Works Co.

Machine Tools—Milling Machines

AMER. ENG., 1911, p. 111 (March).

Illustrated description of vertical and horizontal miling machine of great flexibility; designed by the Newton Machine Tool Works, Philadelphia.

Machine Tools—Shaper AMER. ENG., 1911, p. 116 (March).

Illustrated description of a motor driven crank shaper with speed box. Designed by the John Steptoe Shaper Co.

Shops—Locomotive AMER. ENG., 1911, p. 81 (March).

LOCOMOTIVE REPAIR SHOPS AT BREWSTER, OHIO, W. & L. E. R. R.

Fully illustrated description of a shop to take care of the repairs on 400 locomotives. All shops are contained within one large, well lighted building. An original arrangement incorporating a transfer shop forms the basis of this design.

Steels—Alloy AMER. ENG., 1911, p. 95 (March).

Liberal abstract from a paper presented by Henry Southers before the Engineering Club and Railroad Club at Altoona. It points out very clearly the primary importance of heat treatment of alloy steels.

POSITIONS WANTED

CHIEF DRAFTSMAN.—Graduated mechanical engineer, three years' general shop practice, three and one-half years' office experience in mechanical departments with railroads and steel car manufacturing concerns. Designer, estimator and calculator for all kinds of wood, or steel freight or passenger cars, wants position as chief draftsman or car inspector or mechanical engineer on railroads or smaller car manufacturing concerns. Address N. S. E., care AMERICAN ENGINEER.

CHIEF DRAFTSMAN.—Mechanical engineer, six years' railroad experience, as apprentice, material inspector and general inspector. Four years in railroad supplies as salesman and chief draftsman, now superintendent of factory, wants position as chief draftsman, mechanical engineer, engineer of tests or shop superintendent. Address V. D., care AMERICAN ENGINEER.

The Hanna Locomotive Stoker

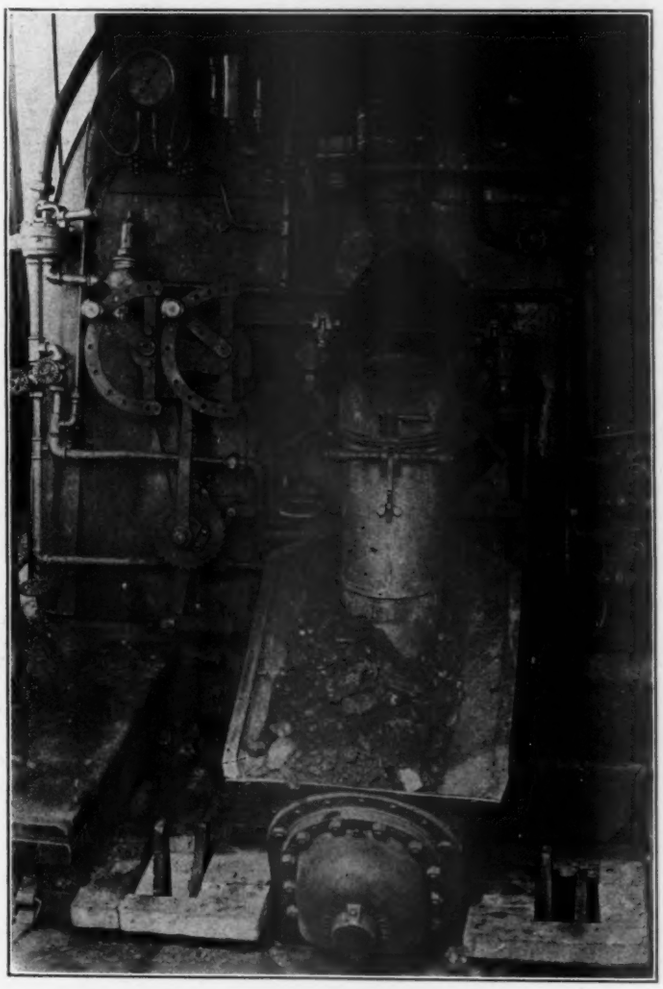
A SUCCESSFUL STOKER OF THE STEAM JET TYPE DESIGNED TO GIVE PERFECT FLEXIBILITY AND CONTROL OF COAL DISTRIBUTION. IT HAS BEEN IN SERVICE FOR NEARLY A YEAR ON A LARGE MALLET COMPOUND LOCOMOTIVE, SUCCESSFULLY DEVELOPING THE CAPACITY OF THE ENGINE WHICH COULD NOT BE REALIZED WITH HAND FIRING.

Locomotive stokers can be divided into three general types, viz., the plunger type, the jet type and the under-feed type. Widely different arrangements of each of these types have been extensively experimented with, most of them with some degree of success. At the present time, however, the examples of the jet and under-feed types appear to be more promising, and of these, three designs stand out very prominently. These are the Crawford, the Street and the Hanna stoker, the first being of the under-feed and the latter two of the steam injection type. All of these have successfully withstood rigorous service tests, and, under the conditions in which they have been operating, can all be regarded as entirely successful.

Though the Street and the Hanna stokers are both of the same general type, they differ in practically all respects. The Street stoker employs a crusher on the tender and chain bucket elevator on the back head of the boiler and feeds the coal through three openings in the back head by means of powerful intermittent steam jets. This stoker will be fully illustrated and described in an early issue of this journal. The Hanna stoker, which is shown in the accompanying illustrations, is a self-contained apparatus and feeds through the fire door.

This stoker has been developed by the Hanna Locomotive Stoker Company of Cincinnati and has been in continuous successful operation on the Cincinnati, New Orleans & Texas Pacific (Queen and Crescent) for considerably over a year, and during the past eight or nine months has been successfully stoking a large Mallet compound locomotive which had proven a failure with hand firing. It has recently been successfully operated on one of the largest Mallet compound locomotives in the world on the Atchison, Topeka & Santa Fe Railway, and is now being applied to a number of locomotives on the Queen and Crescent and to single locomotives on several other railways.

This stoker differs in practically all respects from its predecessors of the same general type and is arranged to automatically distribute the coal around the fire box in a regular cycle, being so constructed, however, that if necessary, a large amount of coal can be directed at any one spot desired, or the cycle can be so altered that part of the fire box will continuously receive a greater supply than another part.

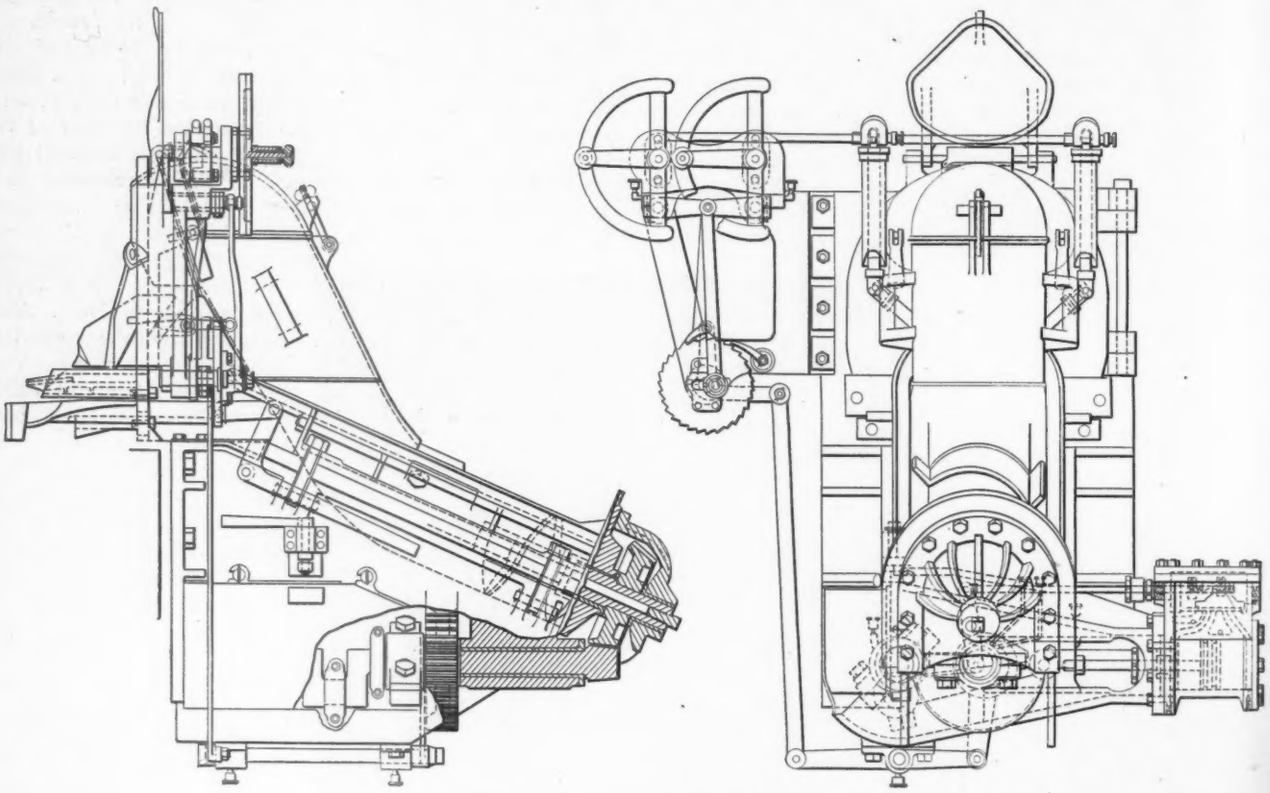


HANNA LOCOMOTIVE STOKER—UPPER COAL HOPPER REMOVED.

As at present constructed, this stoker is built with a hopper holding about 250 lbs. of coal, so located that the fireman can conveniently fill it from the tender. At the bottom of this hopper there is a worm feeder, driven by a bevel gear connection from the small two-cylinder slide valve steam engine self-contained within the machine and located on the deck of the cab close to the boiler head. This worm feeds the coal into an inclined cast iron pipe, through which it is crowded to a discharge in the upper part of the regular fire door opening. The worm in crowding the coal into the pipe crushes it so that there are practically no pieces that will not pass through a 2 in. screen. As it emerges from the top of this pipe it falls down on to a cast iron ridge plate just inside of the door opening, over which there are two inclined wings hinged at the back, and arranged to automatically travel from the top to the bottom of this ridge plate, as will be explained later. These wings form a trough for directing the stream of coal, which then flows down in front of the jets. At this point there is a distinct change from any previous design of stoker, in that there are two sets of jets, the upper emerging from the end of a series of fingers about 3 in. long and arranged in an arc. Directly below these fingers is a very thin, flat opening, from which emerges a thin fan-shaped jet of steam covering practically the whole area of the fire. As the coal flows to these jets the larger pieces strike the fingers and are caught by the jets emerging therefrom and are blown to the part of the fire box served by this particular jet or jets. The finer coal, however, falls between these fingers and is caught by the film jet below. This fine coal is then blown into the fire box with less force and underneath the stronger jets from the fingers, which tend to hold it down on the grate and counteract the effect of the draft while it is in suspension. In this manner only the larger pieces which have sufficient weight of their own to carry them to the grate, are distributed by the upper jets. Below the casting carrying the jets is a table casting which is grooved out on either side in such a form that a certain portion of the coal is carried by means of these grooves into the back corners and underneath the fire door. This table casting is capable of a limited adjustment in and out at will. The steam jets operate continuously and a gauge is provided on each,

which, in connection with the valve on each line, permits the varying of the pressure as the kind of coal and the condition of the firebox dictates. Normally the upper or finger jets are carried at about 20 lbs. pressure more than the lower or film jet. These pressures will vary between 40 and 60 lbs. and 60 and 80 lbs. under normal conditions.

The automatic operation and independent control of the wings on the ridge plate, which gives the direction that the stream of coal shall take and the point where it shall be discharged on the grate, has been very ingeniously and satisfactorily worked out. Each of the wings are rigidly secured at the back ends to a shaft, which is continued through a universal joint to a point on either side above the inlet pipe. Here are secured short cranks having a ball on the outer end. Over these balls are slipped a spring latch, forming the end of the operating gear coming from its control on the left side. This arrangement gives an easy method of disconnecting if desired.

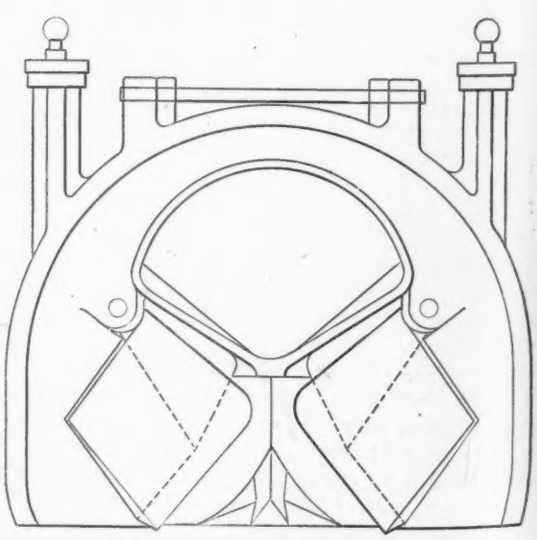


GENERAL ELEVATIONS OF HANNA STOKER.

The rods connecting to the operating gear are secured to the top of a slotted block that is hinged at the bottom to a short crank arm operated by the handles on the quadrants shown at the left of the stoker. In the slot in this block is a pin from the vertical arm of a rocker, which is oscillated by an eccentric connection to the ratchet wheel shown just below the quadrants. The throw of this arm is capable of adjustment. The ratchet wheel is operated through a dog on the end of the bell crank connected by a long arm and rocker from an eccentric on the shaft which drives the worm screw.

Since each of the wings in the stoker have a separate connection and gear from the ratchet wheel, it will be seen that either can be adjusted as to its movement by a change in the angularity of the slotted block. If the control lever is so located that the pinned end of the block is at the bottom, the slot will then be vertical in the central position and the wings in the stoker will have their maximum travel. If, however, this operating lever is turned so that the pin connection is at one side, the pin on the rocker will then simply slide back and forth in the slot and the wing casting controlled from this gear will have no movement, remaining stationary in a position at the top or bottom of its stroke, depending upon which way the control lever is swung. Therefore, necessarily any position of the control handles between these two extremes will give either wing a motion from the bottom part way up its stroke or from the top part way down and return in a regular cycle.

A study of this arrangement will show that by throwing both operating levers at the top, for instance, the two wing castings will form a trough in the center and all of the coal will be thrown underneath the flue sheet and on the forward end of the grate. If they are both placed at the bottom of the quadrants the wing castings will remain at the bottom of their stroke and the coal will practically all be discharged into the back corners of the fire box. If one is placed at the top and one at the bottom all of the coal will then be fed along one side of the fire box, being scattered equally. On the other hand, if one is placed at the top of its quadrant and the other is placed to give a full stroke, a cycle of firing will occur through one-

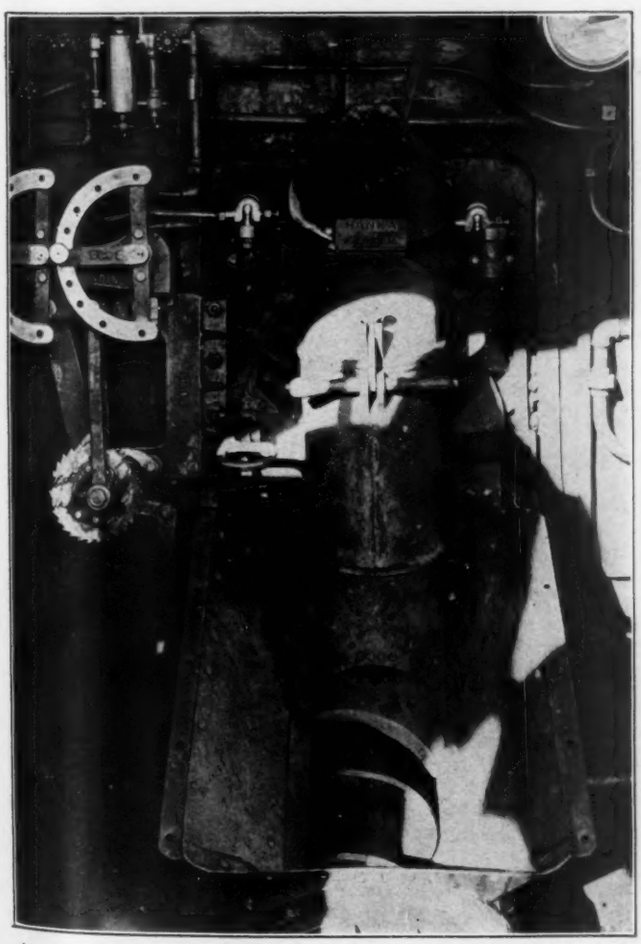


ARRANGEMENT OF RIDGE PLATE AND WING CASTINGS.

half of the fire box only. From this it will be seen that any possible desired combination for the feeding of the coal can be obtained by the proper adjustment of the control handles. If it is desired to put a large amount of coal in the back corners or underneath the door this is performed by placing both handles at the bottom of the quadrants, shutting off the blast, allowing the coal to pile up on the dead plate and then with a quick blast through the fingers it will be discharged immediately under the door and into the back corners almost entirely.

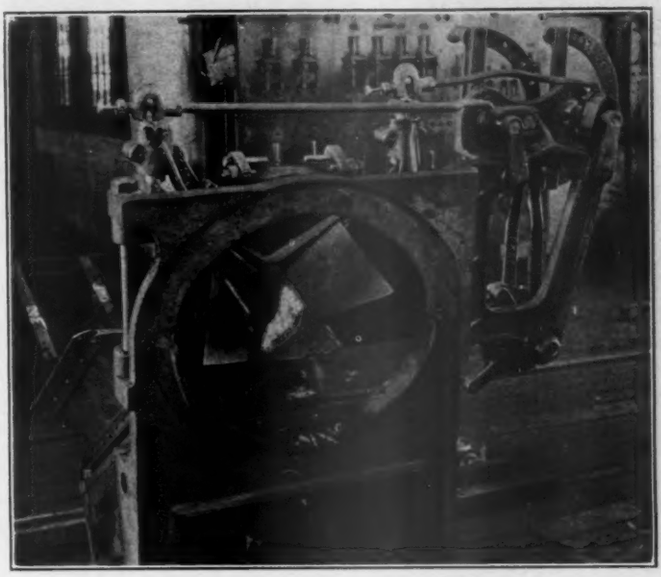
The two cylinder steam engine operating the stoker is of such a size that in case any foreign substance gets into the worm which would break the machine, the engine will be stalled before this actually occurs. A reversing arrangement is provided with a convenient lever, so that if the engine is stalled it can be immediately backed, and the stone or other obstruction can be removed.

A study of the machine will show that its capacity is governed entirely by the speed of the engine driving the worm. The steam jets will take care of practically all of the coal that can be placed in front of them, and the amount of coal put into the fire box is determined by the amount the worm feed will handle, which in turn, of course, is controlled by its speed. The hopper is set at such a height and in such a position that the fireman can supply a very large amount of fuel with no great difficulty or inconvenience. During a recent trip, when the stoker was delivering to the fire box over 5,000 lbs. of coal per hour, it was found that the fireman, who took things very easily, was actually engaged in shovelling coal less than 40 per cent. of his time. If a capacity is desired which exceeds the fireman's ability to shovel it into the hopper the stoker could be rearranged with the hopper covered by a grating at the deck level, and the fuel put into it by a large hoe, or by gravity.



GENERAL VIEW OF STOKER, SHOWING WORM FEED. COAL HOPPER REMOVED.

On a recent trip of this Mallet locomotive between Somerset, Ky., and Oakdale, Tenn., a distance of 91 miles, over 1¼ per cent. grades, with very sharp curves and many tunnels, the stoker being operated by the observer, who received but the



VIEW SHOWING RIDGE PLATE, WING CASTINGS AND OPERATING GEAR. NOZZLE AND TABLE CASTINGS NOT IN PLACE.

briefest preliminary instruction, it was proven to be all that the inventor claimed for it. The fuel on this trip was very poor quality, being of a character with which it was impossible to successfully hand fire, without numerous stops for fire cleaning, but in spite of this the stoker easily maintained a maximum steam pressure under any and all conditions of work. In fact, it was found possible to open the pops at any time desired, even when the train was on a very heavy grade and the locomotive was working at its maximum power. During the trip, which required eleven hours of elapsed time, the grates were not shaken, there was no hook put into the fire, and at the end of the run the fire bed did not exceed eight inches in thickness and was in every way in perfect condition. Although the locomotive was not equipped with a brick arch at no time when running did the smoke assume a shade darker than light gray. This performance is all the more remarkable, since the stoker in use was a new one and had never been operated on a locomotive before this trip. For periods of thirty minutes or more it was called upon to deliver coal to the fire box at a rate exceeding 5,300 lbs. per hour. While in operation the appearance of the fire box equalled that found in the very best hand firing. It appeared as if a large part of the fine coal burned while in suspension, giving an intense white light, indicating perfect combustion.

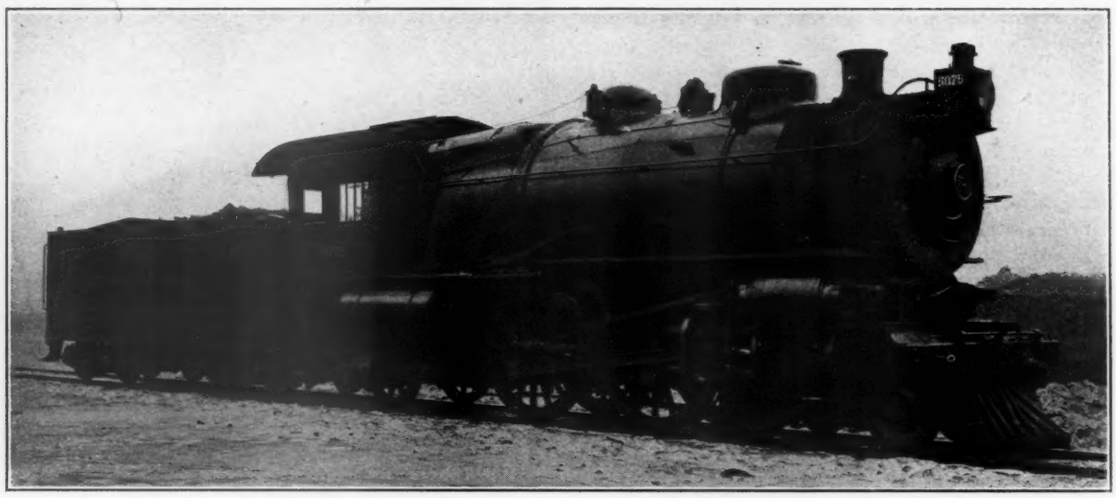
ERIE CHANGES LOCATION OF LOCOMOTIVE HEADLIGHTS.—All of the engines of the Erie are to have their headlights changed from in front of the smokestack to the center of the boiler head, where the number of the engine is at present. Engine No. 1704 on the Cincinnati division was the first on that section of the road to have the change made. The position of the headlight will not be altered until the engines are sent to the shops for other repairs, so that it will be some time before all of the engines on the system are changed.

THE EMPLOYEES OF THE YUEH-HAN RAILWAY, CHINA, are organizing a railway club, and with it a library. For this purpose catalogs of all sorts of railway supplies, and more particularly of rolling stock and shop equipment are desired. E. C. Chang, assistant storekeeper of the Yueh-Han Railway, 32 Fung Yuen Ching street, Canton, China, may be addressed.

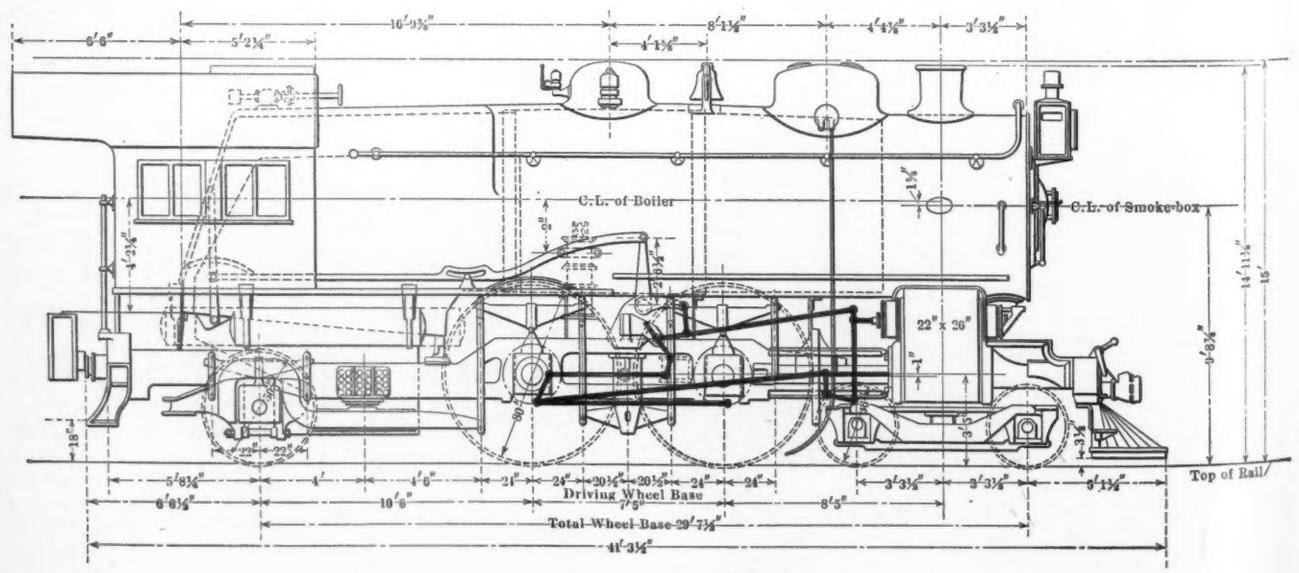
Pennsylvania Atlantic Type Locomotive Class E6

THE MOST POWERFUL ATLANTIC TYPE LOCOMOTIVE EVER BUILT HAS RECENTLY BEEN TURNED OUT OF THE JUNIATA SHOPS OF THE PENNSYLVANIA RAILROAD, AND HAS GIVEN AN EXCELLENT ACCOUNT OF ITSELF WITH HEAVY HIGH SPEED TRAINS ON THE MIDDLE DIVISION OF THAT ROAD, BETWEEN ALTOONA AND HARRISBURG.

An Atlantic type locomotive with 133,300 lbs. on drivers and a total weight of 231,500 lbs. is the latest product of the mechanical engineer's office of the Pennsylvania Railroad at Altoona. The class E3d locomotive, an Atlantic type, with 80 in. drivers, 22 by 26 in. cylinders, 14 in. piston valves, and Walschaert valve gear, having a total heating surface of 2,640 sq. ft. and weighing 188,600 lbs. has been the standard passenger engine of the lines east of Pittsburgh for a number of years. These locomotives, of which there are a large number in service, up to a comparatively recent date have been thoroughly satisfactory in every way for high speed service of all kinds. The general introduction of all-steel passenger equipment, together with the opening of the new terminal in New York City, which resulted in considerable increase in passenger traffic, has increased the weight of the trains to such an extent that the E3d engines were found to be without any reserve capacity for emergencies and the new class of K2 Pacific type engines have been used on a number of the heavier trains. A careful study of the situation, however, showed that the Atlantic type engine was satisfactory in every way with the exception of an insufficiency of boiler power and therefore a new design has been brought out which is practically a duplicate of the E3d except the boiler, which has been very greatly enlarged. The first engine of this new E6 type was turned out of the Juniata shops on December 22, 1910, and road service since that time has checked the correctness of the original deductions and the engine has been found to possess large reserve capacity in service on the most severe schedules, being able to often make up a surpris-

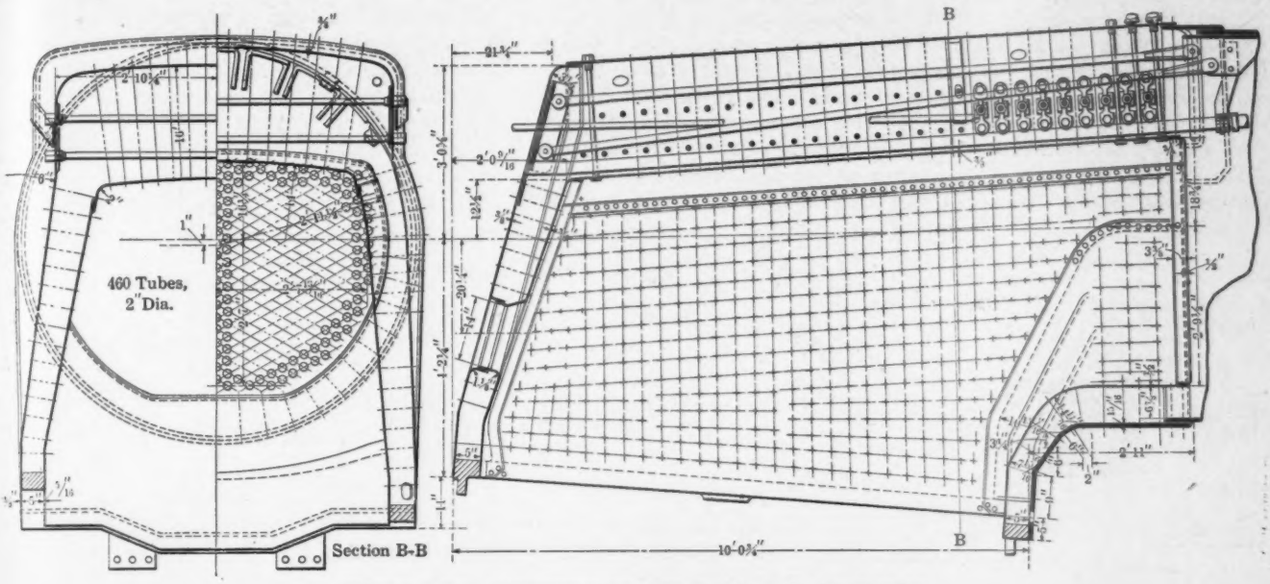


NEW CLASS OF ATLANTIC TYPE LOCOMOTIVE FOR THE PENNSYLVANIA RAILROAD.



GENERAL ELEVATION OF CLASS E6 ATLANTIC TYPE LOCOMOTIVE—PENNSYLVANIA RAILROAD.

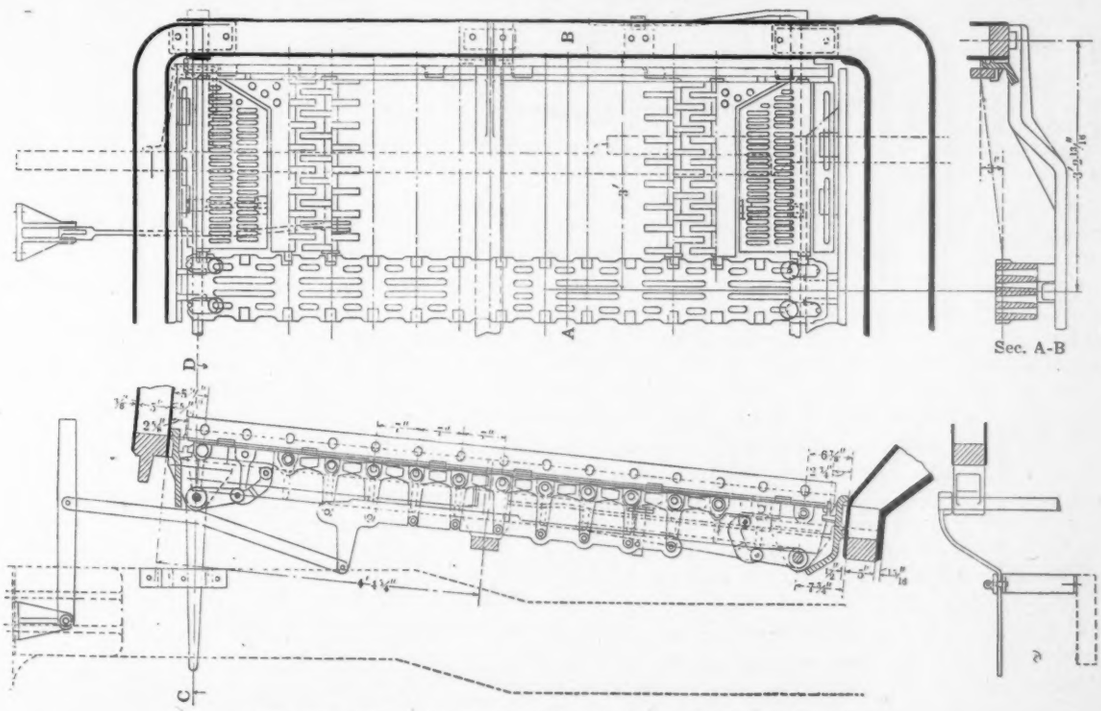
ingly large amount of time over the division. A careful study of the general dimensions and ratios given in the table at the end of this article will show that from all accepted standards this design is by far the most powerful of its type ever designed. If it is assumed that a pound pull at the draw bar can be obtained for 4 lbs. of water evaporated from and at 212 degs. in the boiler, this being a reasonable consumption at 40 miles per hour, with a 30 per cent. cut-off, and it is further assumed that the boiler will give an equivalent evaporation of 14 lbs. of water per square foot of heating surface per hour, it will be found that the locomotive will deliver over 12,500 lbs. draw bar pull at this speed, or practically 35 per cent. more than the E3d under the same conditions.



FIREBOX WITH COMBUSTION CHAMBER—CLASS E6 LOCOMOTIVES.

A weight of 68,770 lbs. on one axle, as is found on the main drivers of this locomotive, far exceeds the record in this respect not only in this country, but probably in the world. This is carried on 9½ x 13 in. journals, giving a pressure of over 556 lbs. per square inch bearing area. The actual service of the locomotive on the road, however, has shown that this is not outside of good practice, and there have been no hot bearings or pins on the engine during its three months' most difficult experience.

As above mentioned, the running gear is, with the exception of the trailer truck, a practical duplication of the class E3d, and the boiler is very similar in arrangement and capacity to the class H8b consolidation locomotive.* It is of the Belpaire wide fire box type, 76¾ in. inside diameter at the front ring and contains 460 2-in. tubes, which are 13 ft. 11⅝ in. in length. These are somewhat shorter tubes than were used on the H8 and a combustion chamber has been incorporated. One of the illustrations shows the firebox with this combustion chamber and it will be noticed that the inside throat sheet is flanged to form the bottom of the combustion chamber, thus eliminating a very troublesome joint. It will be seen that the sheet is flanged



ARRANGEMENT OF GRATES ON NEW ATLANTIC TYPE LOCOMOTIVE.

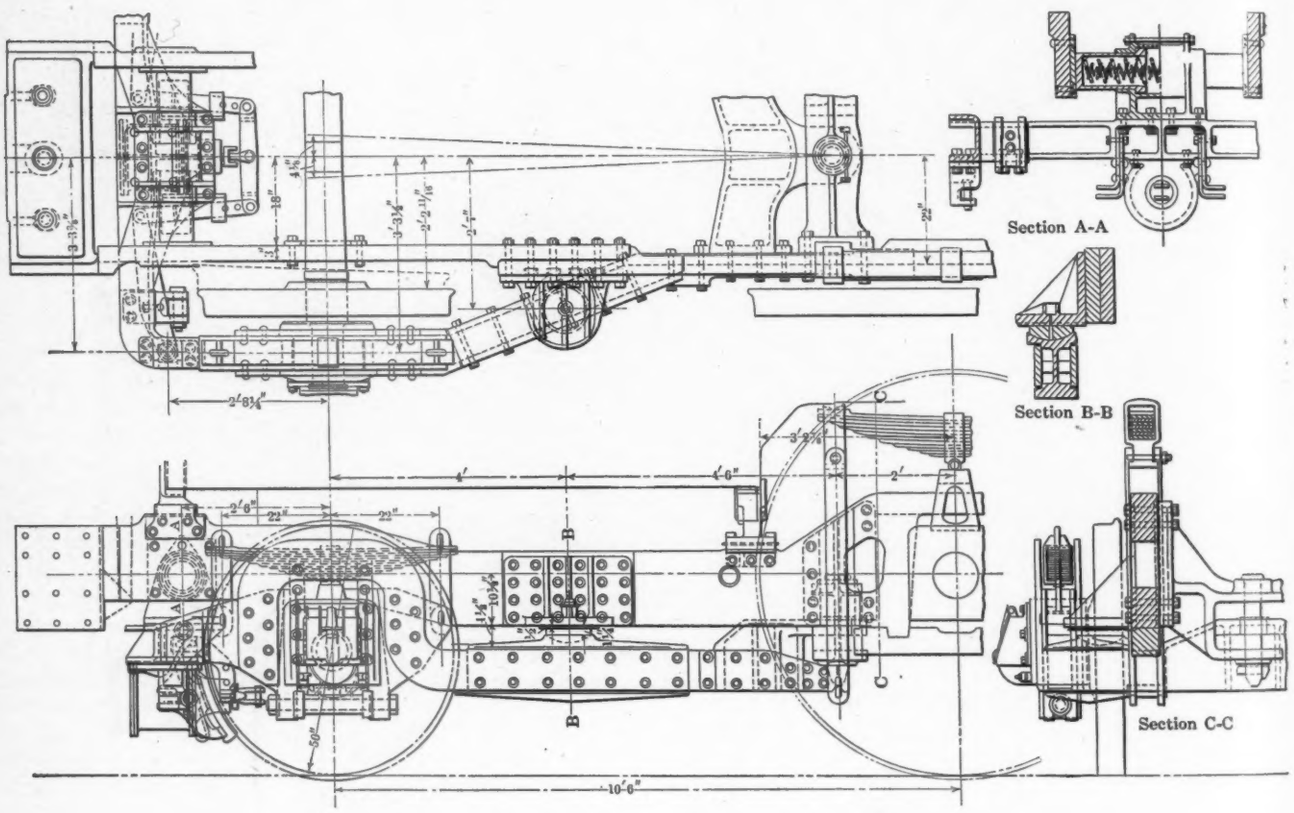
* See AMERICAN ENGINEER, Feb., 1910, page 69.

at a large radius and that ample water space has been left around the circular section. Although the sides of the mud ring are straight the rest of the firebox narrows down toward the back in the same manner as does the H8 boiler. The total heating surface is 3,582 sq. ft. as compared with 3,839 sq. ft. in the H8, the reduction being due to the shorter flues, and 2,640 sq. ft. in the E3d. This gives 314 sq. ft. of heating surface to one cubic foot of cylinder volume and 1,312.09 sq. ft. of heating surface to the weight of one cylinder full of steam. The grate area of 55.13 sq. ft. is the same as on the H8, and slightly smaller than on the E3d, and has a ratio of practically 1 to 65 with the heating surface. This ratio was 47.52 on the E3d, indicating that a higher rate of combustion is to be obtained on the new engine. If, as has been assumed above, an equivalent evaporation of 14 lbs. of water per sq. ft. of heating surface per hour is to be attained it will be necessary to burn over 6,000 lbs. of coal per hour or practically 110 lbs. per square foot per hour. While, of course, a fireman is able to deliver coal at this rate for a short time, it is probable that one fireman will not be able to develop the full capacity of the locomotive continuously and as a matter of fact the service for which it is designed will not require the full capacity continuously.

Reference to the illustration will show the arrangement of the grates, wherein a very wide dead grate is used in the center and four drop grates of liberal area are provided. All of the grates on either side are arranged to shake from one connector.

An entirely new design of trailer truck with outside journals, which has many features of interest, has been incorporated in this design. The frame and equalizers have been combined and the weight is transferred through a combination semi-spherical and sliding bearing placed between the engine frame and the trailer frame or equalizer. Provision is made at the pivot pin for 3 in. vertical movement in either direction. A substantial spring centering device is incorporated, arranged as shown in the illustration, and the brake cylinder for the trailer truck brakes is also carried at the rear of the trailer frame. It will be noticed that a grease cup is provided above the bearing point, so arranged as to keep both the flat and the spherical surfaces properly lubricated. An inspection of the illustration will show the details of this arrangement.

Although the main frames in general are from 4 to 4½ in. in width, and 6⅜ in. in depth on the upper rail, at the driving pedestals they have been widened out on the inside to 7⅞ in. in width and narrowed in depth to 4⅜ in. An unusually substantial connection between the front and main frames is evident from the drawing showing the frame details. A study of this drawing will show that the utmost care has been used to provide proper strength at the points subjected to the greatest stresses and at the same time to make the whole construction as light and flexible as possible. The pedestal braces are most substantial and are secured by two bolts at either end.



NEW DESIGN OF TRAILER TRUCK APPLIED TO THE CLASS E6 LOCOMOTIVES.

The Walschaert valve gear used is the same as has been previously applied to the class E engine.*

The general dimensions, weights and ratios of the locomotive are given in the following table:

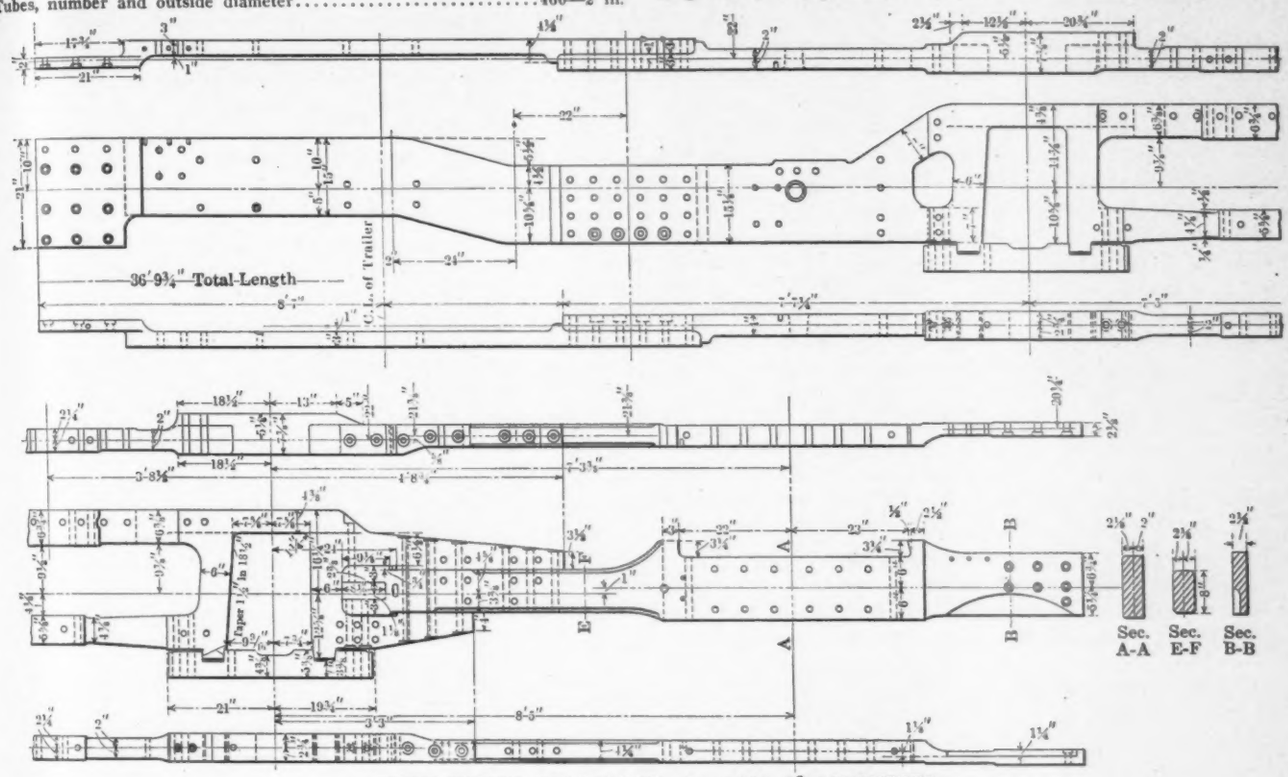
GENERAL DATA.	
Gauge	4 ft. 8½ in.
Service	Pass.
Fuel	Bit. Coal
Tractive effort	25,797 lbs.
Weight in working order	231,500 lbs.
Weight on drivers	133,300 lbs.
Weight on leading truck	51,270 lbs.
Weight on trailing truck	46,930 lbs.
Weight of engine and tender in working order	389,500 lbs.
Wheel base, driving	7 ft. 5 in.
Wheel base, total	29 ft. 7½ in.
RATIOS.	
Weight on drivers ÷ tractive effort	5.18
Total weight ÷ tractive effort	8.97
Tractive effort × diam. drivers ÷ heating surface	578.00
Total heating surface ÷ grate area	64.97
Firebox heating surface ÷ total heating surface, per cent	6.10
Weight on drivers ÷ total heating surface	37.10
Total weight ÷ total heating surface	64.60
Volume both cylinders, cu. ft.	11.40
Total heating surface ÷ vol. cylinders	314.00
Grate area ÷ vol. cylinders	4.85
CYLINDERS.	
Kind	Simple
Diameter and stroke	22 x 26
VALVES.	
Kind	Piston
Diameter	14 in.
Greatest travel	7 in.
Outside lap	1 5/16 in.
WHEELS.	
Driving, diameter over tires	80 in.

* See AMERICAN ENGINEER, July, 1908, page 253.

Driving journals, main, diameter and length	9½ x 13 in.
Engine truck wheels, diameter	36 in.
Engine truck, journals	5½ x 10 in.
Trailing truck wheels, diameter	50 in.
Trailing truck, journals	6½ x 12 in.

BOILER.

Style	Belpair
Working pressure	205 lbs.
Inside diameter of first ring	76¾ in.
Firebox, length and width	72 x 110¼ in.
Firebox plates, thickness	3/8 & ½ in.
Firebox, water space	5 in.
Tubes, number and outside diameter	460—2 in.



THREE SECTION FRAMES USED ON CLASS E6 LOCOMOTIVES.

Tubes, length	13 ft. 11⅝ in.
Heating surface, tubes	3,364 sq. ft.
Heating surface, firebox	218 sq. ft.
Heating surface, total	3,582 sq. ft.
Grate area	55.13 sq. ft.
Smokestack, height above rail	14 ft. 11⅛ in.
Center of boiler above rail	9 ft. 8⅞ in.

TENDER.

Wheels, diameter	36 in.
Journals, diameter and length	5½ x 10 in.

TWENTY-FIFTH YEAR OF THE RAILWAY CONGRESS

The International Railway Congress Association was established in 1885, and Mr. Weissenbruch, general secretary, prints in the *Bulletin* for January a historical review of its work during the quarter century. At the first session (in Brussels in 1885) the Congress represented 19 governments, 131 railway systems and 31,000 miles; and the number of delegates present was 289. At the eighth session, in Berne, Switzerland, last year, the number of governments represented was 48, railway systems 420, and mileage of railways 359,858; and the number of delegates present was 799. An abstract of the principal topics which have been discussed by the Congress and the conclusions thereon fills 100 pages of the *Bulletin*. As to the function and usefulness of the association, Mr. Weissenbruch says:

It has been said in the daily press that the conclusions adopted at the general meetings have too often been general expressions in which the general public would vainly look for definite and precise solutions. These conclusions are necessary for starting the discussions, but they must be drafted in such a way as to make it possible for them to be adopted without too much opposition at the general meetings where the delegates who have specially studied them are relatively few in number. Every step in advance is in its origin the work of a minority; it must raise some doubts in a meeting where the majority has not yet recognized its necessity. But what does it matter? At the same time while the meeting formulates its impersonal opinion, each of the managers of engineers present at the meeting forms or modifies his personal opinion. His attention is drawn to the question. When he reaches home, he studies it again. He is much assisted both by the documents he brings home with him as well as by the relations of friendship or of mutual esteem which he has formed at the periodical meetings of the Congress. It is thus by no means one of the least results of the Congress Association that it forms, for railway men, a stimulus which takes them away from their daily routine. How much useful work may thus result from intelligent and better directed zeal!

RAILROADS' GROSS EARNINGS FOR 1910

The gross earnings of the United States railroads for the calendar year 1910 amounted to $2,825,246,281, an increase of $229,490,446, or 8.84 per cent., as compared with the preceding year. Commenting on this showing the *Chronicle* says:

"Unfortunately the gain in gross earnings, notwithstanding its magnitude, hardly sufficed to meet the rise in operating cost and the resulting enormous augmentation in expenses. It was this latter feature that furnished such grave cause for apprehension and induced the vigorous efforts on the part of railroad officials to raise rates—efforts which the recent decision have now settled. The principal item in the augmentation in expenses was the advances in wages which the carriers were obliged to make in practically all grades of the railroad service. It is testimony to the way in which expenses have been mounting up that this great gain in gross receipts should have been practically wiped out, and none of it saved for the net, and perhaps more than wiped out, because as yet it is not possible to state whether the total of the net will show a trifling increase or actually record a loss."

Following is a summary of the gross earnings from January 1 to December 31 for a series of years:

Year.	Gross Earnings.	Increase.	
1894	$1,046,616,407	*$130,205,328	11.07%
1895	1,086,464,608	62,202,827	6.05%
1896	1,114,430,883	206,004	0.02%
1897	1,185,154,654	62,337,075	5.55%
1898	1,253,807,714	81,030,578	6.98%
1899	1,332,666,853	118,980,243	9.81%
1900	1,459,173,305	113,972,300	8.46%
1901	1,603,911,087	148,988,902	10.24%
1902	1,705,497,253	100,863,714	6.28%
1903	1,918,652,252	202,193,361	11.77%
1904	1,966,596,578	8,765,279	0.45%
1905	2,099,381,086	169,998,137	8.76%
1906	2,374,196,410	241,913,596	11.34%
1907	2,595,531,672	221,642,861	9.33%
1908	2,235,164,873	*301,749,724	11.90%
1909	2,595,466,402	278,038,372	11.65%
1910	2,825,246,281	229,490,446	8.84%

* Decrease.

DIRECTORS OF THE NEW HAVEN have approved plans for a new stone and brick station in New Haven that will cost $1,000,000. It will be 1,000 feet long and about 500 feet wide, and is to be completed one year hence.

Development in Tool-Room Methods

A REVIEW OF WHAT HAS BEEN BROUGHT ABOUT IN CORRECTING THE STANDING ABUSES OF THE RECENT PAST, AND A COMPARISON BETWEEN THE IDEAL CONDITIONS OF THE PRESENT, IN THE LINE OF IMPROVED FACILITIES, AND THE PERIOD WHEN FEW TOOL ROOMS EXISTED, AND LITTLE, IF ANY, SYSTEM WAS IN EVIDENCE.

The fact is now generally recognized that proper and economical work depends upon the tools used, the condition in which they are kept, and their availability for service, when needed. It may be safely asserted, in fact, that these three requisites constitute the sole requirements, with the possible exception of efficient labor, and this latter need scarcely be reckoned with seriously, as experience has shown that it will logically follow when ideal tool or shop conditions become in order.

A careful and unbiased review of what has been accomplished through various efficiency schemes, so called, points conclusively to the fact that whatever good results may have been attained are due as much to improved shop and tool conditions as to any other features pertaining to these systems. Inquiry along these lines would lead to the inference that a complete metamorphosis in ancient and wasteful methods, such as was necessitated as a preliminary to the advent of any system, practically turned the trick. In other words, the vastly better facilities provided served the purpose far more to the point than the methods of doing work, time studies, etc., which constitute the system proper, although the latter, or the idea embodied, invariably receives all of the credit.

It is no doubt fully appreciated without this comment that up to about fifteen years ago little, if any, system of looking after tools prevailed anywhere. Few locomotive terminals provided the semblance of a tool room. The wrenches, jacks and even the special devices were scattered promiscuously about the roundhouses, and many of the former, which through necessity should have been common property, such as steam pipe wrenches, and even spring pullers, were actually locked up in the cupboards of the machinists who happened to see them first. It is recalled in this connection that on the occasion of a search through a prominent Eastern roundhouse, simply to test the situation, during the period referred to, failed to reveal a single wrench, even including the commonest sizes of those days, seven-eighths, inch, and inch and one-eighth. What jacks were visible had galled threads, and jack levers were absolutely at a discount.

The effect of such a situation on a new man coming to work, or an apprentice just out of his time in such a shop, could not be other than most depressing. His usefulness was practically nil until he had been there long enough, generally five or six months, to beg, borrow or steal, as a rule the latter, a sufficient number of working wrenches. Beyond furnishing him with a machinist's kit, *i. e.*, a hammer, large and small monkey wrenches, and a flat and a cape chisel, the various companies did absolutely nothing to help him out. Files, of course, could be drawn from the storeroom, as could emery and emery cloth, and occasionally a soft hammer, but this was all; and there were many other things necessary for the simplest operations in running repairs. Among the number actually required were open-ended wrenches, three-quarters, seven-eighths, inch, and inch and one-eighth, also socket wrenches of the same sizes. To secure these devious ways and means were resorted to.

In those happy-go-lucky days almost every engine had a good set of tools in the right hand seat box, laboriously collected by the engineer who practically owned the same engine for years. The most common resort was to break this box open at a favorable moment and abstract from the contents what was required. Sometimes, but very seldom, an obliging blacksmith would make a wrench or so for the new machinist, and a master mechanic has been known to write an order on the blacksmith for a set. Besides wrenches, there had to be included in the kit a three-quarter inch hexagon steel pin bar, assorted size stud nuts, a rough forged auger-shaped arrangement for grinding check valves, and many other things no need to mention.

It will be thus readily appreciated that it became a source of laborious endeavor to gradually accumulate a set of working tools, and there is much food for thought in speculating on how much money was lost by the company on a man's time while he was engaged in gathering the various items. Still the shop management appeared to absolutely disregard this factor, and it may, perhaps, be well to make some little explanation of its singularly complaisant attitude in the presence of a situation so uneconomical, to say the least.

Familiarity with those days, of say twenty years ago, leads to the conclusion that the indifference of the master mechanics must have arisen from lack of knowledge of the actual conditions, and this in turn may be explained through the fact that organized labor had not yet invaded the railroad field. There was no shop committee to present these things as grievances, which they would be quick to do now, to the shop management, and furthermore, labor of any grade, with the possible exception of the engineers, was not self-assertive. A machinist would not think of telling a master mechanic that he needed tools to work with. If he mentioned it to the foreman he would be told to do what the rest had to do—"hunt for them."

Conditions in the machine shops, at least in the large majority, were equally distressing with those present in the roundhouses. The apprentices, who performed the greater part of the machine work, had to beg the blacksmiths to make their lathe or planer tools. Every tool was zealously guarded during the day, and as carefully locked up at night. To secure additional protection the boys took accurate measurements of the width of their tool post slots, and had their tools made just a mere shade smaller. This insured that they could not be used in a narrower tool post, and so minimized the liability of theft. No one was foolish enough to have his tools made the size of the narrowest tool post, and the unfortunate assigned to the machine carrying the latter usually held the position of general victim for tool despoliation.

If an apology for a tool room existed in such machine shops it had no attendant. It was a shack erected in one corner, and contained a few unlettered or unnumbered rough bins in which taps and reamers were piled in random heaps. Many of the taps were broken so that they could only by the greatest skill and patience be inserted in a hole, and the cutting edges of the reamers were generally in bad shape. Apprentices used to be very hard on hand tools; in bottoming taps, reaming, or trying to ream one-eighth inch, etc., and if anything broke it was easy enough to throw it in a bin and say nothing about it, there being no check on the action. This invariably applied to ratchets, a very common tool of the period where everything was hand work. It was simply up to the caliber of the mechanic, whether he broke it and left it in a roundhouse pit, or repaired and returned it.

This might be prolonged indefinitely, but enough has been said to illustrate the point. Some of it may seem exaggerated, but on the contrary it is far from being exploited in its full gravity. It is not intended to say, of course, that what has been commented upon is representative of the general situation, but many more than one big system can be recalled at this writing which embodied these conditions. Although no greater contrast between the then and now can possibly be imagined, still it is well remembered that the Baltimore and Ohio ran clear up to the receivership in 1896 in just this fashion. This and many

other roads provided no tools for roundhouse men except of the most primitive description, and had no check on those that were provided.

It is believed that two principal factors predominated in contributing toward the increased output, or the increased efficiency, which means practically the same thing of the present contrasted with the past, and these: the advent of some form of compensation for labor, other than day work, and the gradual materialization of organized labor. The first required a preliminary overhauling of the shops to see if the proper appliances existed to handle the various proposed piece or bonus work schedules, thus bringing to light the alarming nature of the tool situation, where possibly it was unknown before, and the second provided the means to keep the management advised by the men themselves of a falling off in any tool standard which may have been established.

The reform in this regard which characterizes the present was not, however, effected in a day. There was much planning and many preliminary maneuvers extending over weeks and even months before even a semblance of one of the now standard systems became established. The first move was to "raid" the machinists' cupboards, which was not effected, by the way, without considerable opposition, but the harvest of wrenches and what not garnered therefrom served as the nucleus of many a future toolroom. Nothing was left but the ordinary working kits, and after the first wrench of parting with their laboriously gathered possessions had passed, the machinists and boilermakers felt pretty good after all, because they realized that so long as their company had assumed this arbitrary action it was up to it to provide for their needs in the tool line thereafter.

That the various companies have done so needs no comment. With their attention called to the abuses which had prevailed, they readily appreciated that in order to facilitate work, system must prevail in the care and distribution of tools, so that excessive numbers of them would not accumulate, and with further refinement, so that expensive tools would not be kept idle in one place when needed in another. System was inaugurated in the standard designs of tools and in methods adopted for doing work, with economy and good work always as the ends in view.

In pursuance of these objects the majority of the railroads unconsciously, almost, gravitated toward the plan of some central supervision for the various tools and operations; some authority to decide on the design of tools, jigs, special devices, etc., and all suggestions as to change in methods, new forms of tools, and what not, to be submitted to and receive the approval of that office before being adopted. This was necessary, of course, as often ideas and methods are developed at considerable expense in one place, when they have been already tried and proved unsatisfactory elsewhere. The plan of community of ideas between shops, to insure which the chief tool inspector, general inspector, or whatever his title may be, is responsible, promptly served to eliminate this useless expense. It was a remarkable transition from the former random period referred to when operations at one division shop were too frequently a sealed book to another maybe only one hundred miles away.

The intelligent handling of this scheme has worked out some truly wonderful results, and has brought improved conditions for shop workmen almost inconceivable when compared with the situation only twenty years ago. It is rare indeed at the present time to hear the old complaint—"Nothing to work with." The men know that the facilities are there and it is simply up to them to make good, whereas heretofore there was always a loophole to retire behind the old excuse and the company could not consistently dispute the justice of the plea.

While the tool regulations differ in minor points between the various roads an exhaustive review of many indicates that the highest ideals and standards are arrived at, and it may be safely said that anyone of them followed as indicated will leave nothing to be desired, from the double standpoint of convenience for the workman and efficiency and increased output for the company.

A review of these various regulations prevailing on different roads would no doubt prove of considerable value, but in the interest of brevity it is thought best to confine to one road; the Atchison, Topeka and Santa Fe, whose tool system, developed from the best practice in use at first-class shops, is quoted below:

1. Perpetual or continuous inventory will be had of all tools, machines and devices of all sorts at each shop, showing location of tool, whether assigned to tool-room stock or to the permanent use of an individual man or gang.

2. Uniform aluminum checks of special design, six to each man, will be furnished from Topeka for each shop, indicating shop and the block number of the mechanic to whom issued; these checks will be issued only to such men as required to call on the tool-room for tools. Topeka will be called on for such checks as are required from time to time, which will be forwarded by railroad mail.

3. Standard tool lockers will be assigned to men using tools, as far as practicable.

4. Standard tool kits, for each class of occupation, will be determined upon, and these kits supplied to the man when he enters the employment, he signing up for them, and being held responsible therefor; the man will also be held responsible for the checks issued.

5. A regular periodical, weekly inspection system of all tools will be inaugurated as rapidly as it can be organized. In addition to these general measures the following special regulations will be in force:

6. No tools issued from tool-room except for tool check.

7. No new hand-hammers or monkey wrenches to be given in exchange for old ones unless accompanied by an order from the gang foreman, and marked "O. K." by the shop foreman; chisels and soft hammers to be the only tools exchanged for news ones without a written order.

8. No letters or figures to be given out in lots of less than a full set.

9. All tools out on check must be turned into the tool room every Saturday night, before the tool keeper leaves the shop. In all cases where tool checks remain on the board over Sunday, the tool keeper should notify the tool-room foreman or the general foreman, and the men whom these checks belong to should be required to give an explanation for not returning the tools. In some shops it may be desirable to check up the tools daily.

10. In all cases of broken, lost or damaged tools, the tool check will not be returned until the tool clearance card has been personally signed by the general foreman as per circular letter.

11. In places where, in addition to tools, the tool-room is used for a sort of shop sub-store for small engine supplies, such as cutters, small bolts, etc., the gang foreman's orders will be honored for these supplies.

12. The custody of all high speed lathe, planer and boring mill tools should come under the tool-room foreman, or the man in charge of the tool-room. A man starting to work on a machine requiring these tools should be given a set, and these should be charged to him. Should he break one of these tools, he will exchange it for a new one in the tool-room. The tool-room foreman or the tool man should get a list of the number of high speed tools, the list showing size and style now at various machines, and the workmen should sign up for them.

13. All air motors must be returned to the tool-room every Saturday night, and be thoroughly inspected and oiled before leaving the tool-room again. At shops like Topeka, Albuquerque, San Bernardino, and Cleburne, it may be desirable to assign certain motors to a gang and that this gang be allowed to use these motors during the week, turning them into the tool-room on Saturday night for regular inspection. All motors should be numbered and a record kept of what gang they have been assigned to. Where parts of motors are missing the motors should not be accepted without authority of the tool-room foreman. It should be the tool-room foreman's duty to see that all motors are regularly inspected and repaired and oiled as often as necessary, which, for motors in service should be as often as once a week.

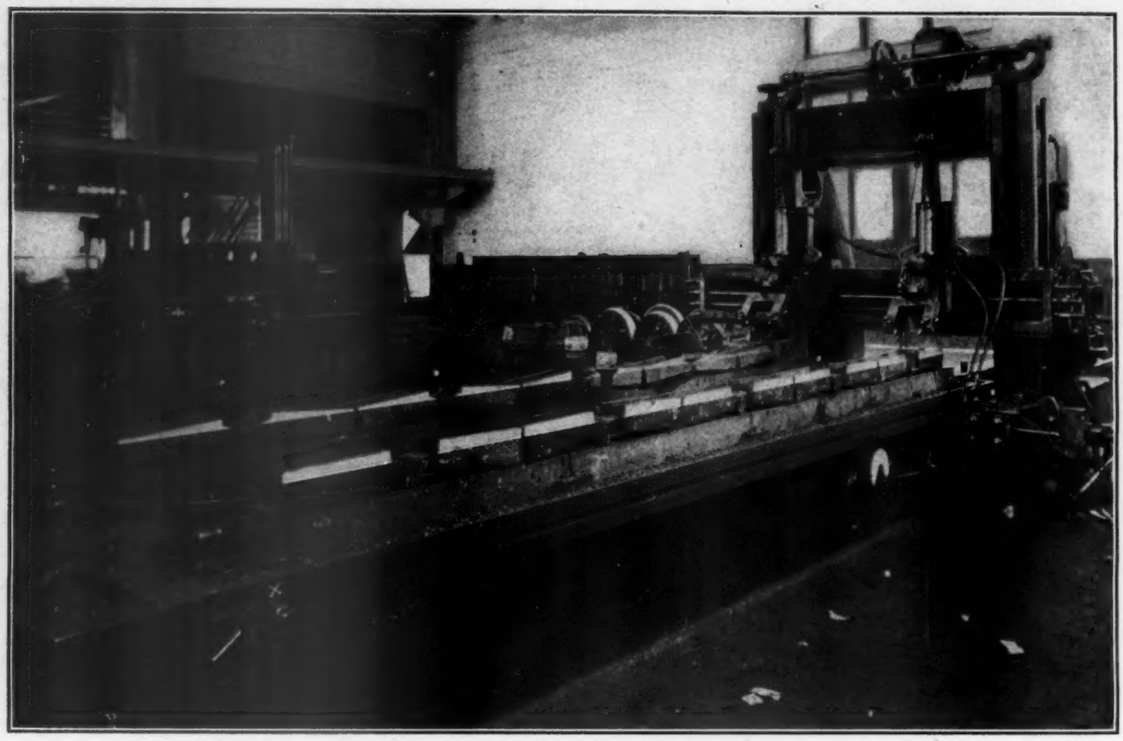
It will be readily appreciated that if the above is adhered to, and there need be no uncertainty on that point, the workman of to-day is enviably situated in comparison with his prototype of yesterday, and unquestionably his employers are better off. So long as the tools are practically put into his hands in the very best condition, the mechanic must perforce work, and a long stride is made at once toward efficiency. On the Santa Fe, in addition to this refinement in tool accounting, standardization of tools and methods has been gone into in great detail, and the Erie Railroad is not far in the rear. The movement is now general to avoid all random methods, and superfluous tools and concentrate on those most efficient, practical and suitable for general use.

GREAT ELEVATOR FOR THE GRAND TRUNK.—With its recent completion the Grand Trunk now has at West Fort William the greatest elevator in the world, its capacity being 3,250,000 bushels. It is the first of a unit of six to be built, with a total capacity of 10,000,000 bushels, and which will have three piers. Then it will be possible to unload 2,400 cars a day, and discharge 300,000 bushels per hour into vessels.

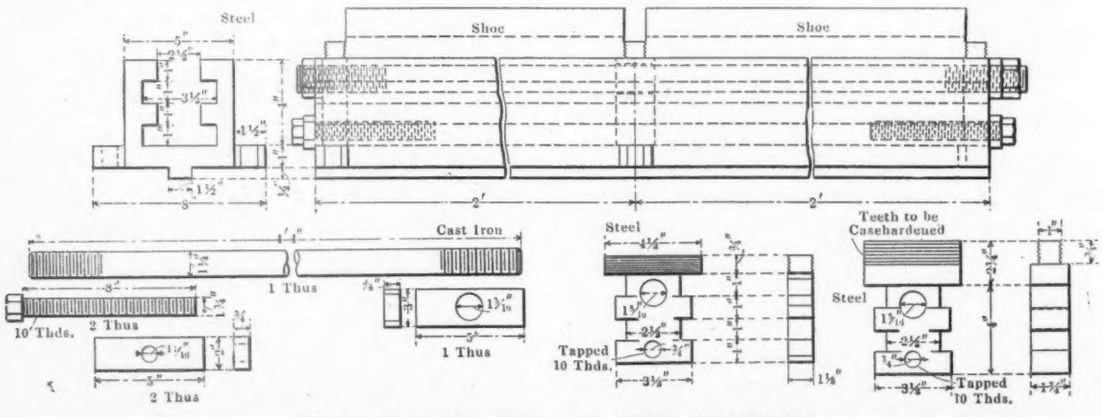
DEVICES FOR MACHINING LOCOMOTIVE PARTS

CENTRAL OF GEORGIA RY.*

Considerable ingenuity is being displayed on Southern railroads at present in working out improved methods for doing work, and particularly in the line of time and labor saving devices for machine shop work. Some of these latter are remarkably efficacious in serving the purpose for which designed, and a careful study of their details, as shown in the drawings herewith, with a view to adopting them for similar work anywhere, will prove to be time well spent. They point conclusively to the fact that the South is not lacking in its full quota of clever mechanics who are continually on the alert to originate and develop schemes for the betterment of their existing shop facilities and methods.



CHUCK FOR PLANING SHOES AND WEDGES.



DETAILS OF PLANER CHUCK FOR SHOES AND WEDGES.

The Central of Georgia Ry., some of whose special shop devices have previously been described in this journal, has been well in the vanguard of this progressive movement. Its Macon shop management has perfected and installed a number of home-made appliances which have vastly increased the output, and at the same time have secured a remarkable reduction in the former costs of doing work. Those illustrated in connection with this article are the latest additions to the shop equipment, and have been carefully worked out with the end in view to secure a still further refinement in the results desired. They are in daily service, and are now no unimportant factors in the general efficiency to which the Macon shops have been raised.

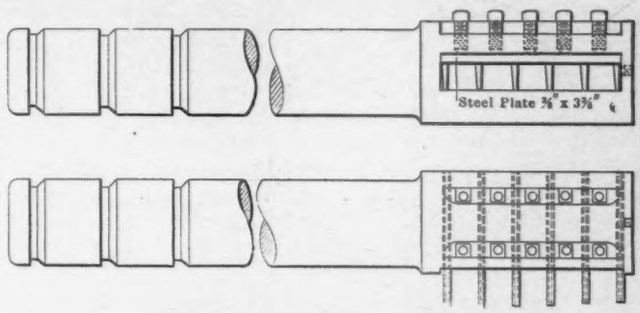
A particularly desirable accessory to any locomotive machine department may be found in the chuck for shoes and wedges, which is illustrated in half tone and in detail arrangement. It will be noted that this device is very simple, requiring very little time and labor to chuck the shoes or wedges, and it can be used on either a planer or milling machine. The chuck shown in the photograph is made up of several sections, so that it can be used on various lengths of planer beds, although there is nothing to interfere with making it of any length which local conditions may dictate.

In order to grip the work securely it is only necessary to tighten up the 1¼ in. nut on the rod end of the chuck. This holds the work solidly and sufficiently to stand any kind of cut, requiring only two chuckings to complete the job. The first chucking is as shown in the photograph, where the outside of flanges, inside of flanges, and bottom of frame fit are finished. The remaining operation is merely to re-chuck the shoes and

* Macon shop, W. H. Fetner, Master Mechanic.

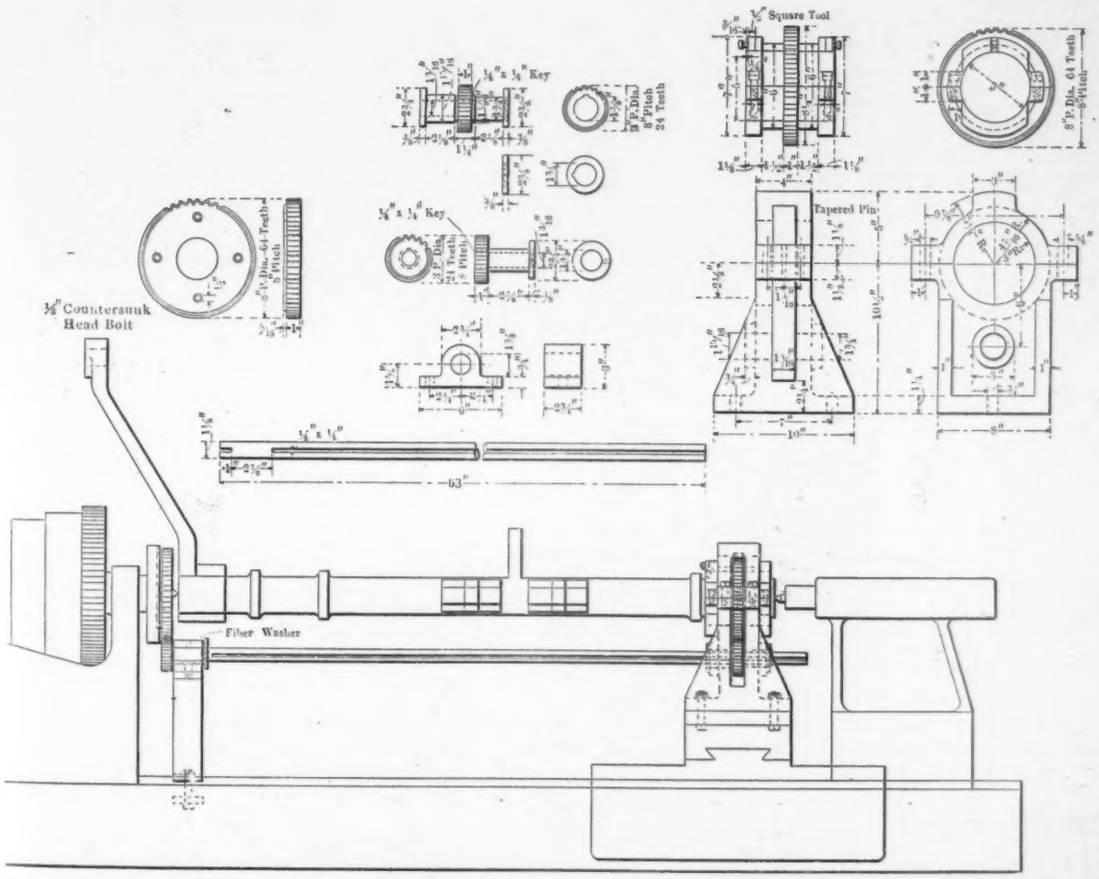
wedges to plane for the driving box fit. It will be observed that in the case illustrated a double cutter, or forked tool, is in use. This finishes the outside of the flanges in one cut, and machines the inside of both flanges and the bottom, or frame fit, of the shoes or wedges with one tool. An ingenious idea has been cleverly worked out in this connection to prevent the dragging of the tools on the back stroke of the planer. The photograph shows a small air cylinder on each head of the planer above the tool. This operates automatically with the reversing of the table, and lifts the tool clear of the work as shown until the return stroke is completed. This entire combination is probably the best arrangement yet devised for heavy, rapid and accurate shoe and wedge planing, and reflects much credit on those who so carefully worked out the details.

The question of turning the bearings of lift or tumbling shafts has been one in receipt of considerable attention in the past, and many devices of more or less merit have been evolved in various quarters to cope with it. While the majority of these, no doubt, performed the work for which they were built, it still cannot be said that any one of them has proved entirely satisfactory. The majority embody the serious fault of undue complication, a feature which necessarily implies a great deal of time in setting them up and in preliminary adjustments before any real work can begin. The difficulty, however, in some shops of securing a lathe of sufficient swing to clear the reach rod arm has necessitated a resort to some form of special device.



GANG TOOL FOR CYLINDER PACKING.

The gang tool for cutting packing rings is one of the minor devices which have been evolved at Macon, but is equally serviceable in its own field. The drawing is self-explanatory, but attention may be called to the provision which it embodies for making any adjustment which may be necessitated by varying conditions that may arise. Although the cylinder packing rings used on this railroad are practically standardized, the fact

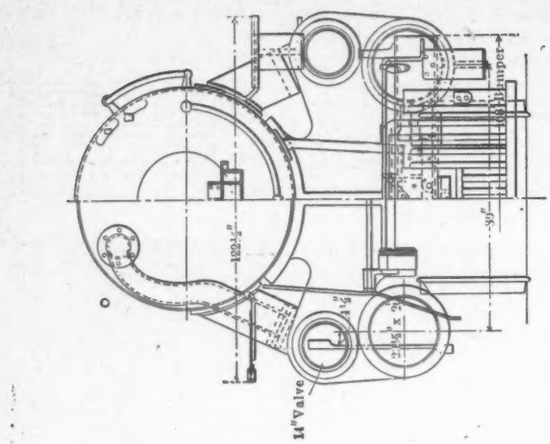


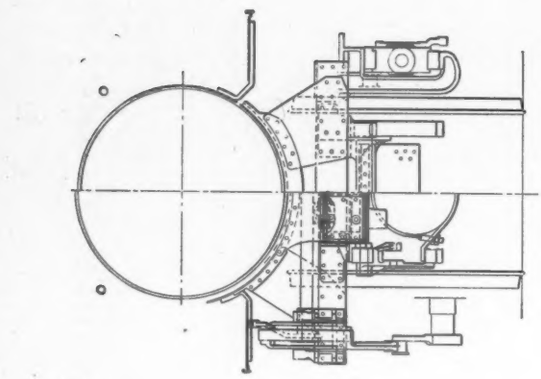
GENERAL ARRANGEMENT OF DEVICE FOR TURNING LIFT SHAFT BEARINGS.

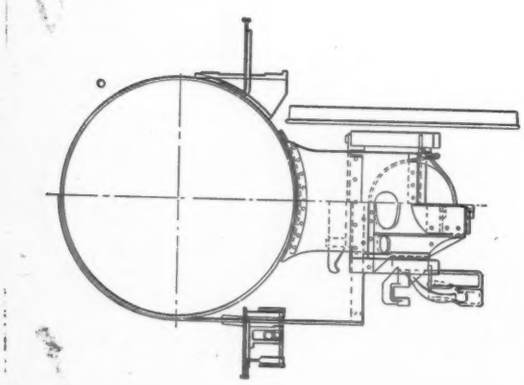
That herein illustrated in detail was designed in the Macon shops for doing this work on a tumbling shaft with solid arms and inside bearings, but it can be used equally as well on an outside as on an inside bearing shaft. As it is plainly apparent, the device is surprisingly free from the multiplicity of parts which is so characteristic of the existing attempts along similar lines. It can be applied to any lathe with 24 in. swing or greater, and gives an absolutely smooth bearing, turning the shaft in about the same time that a straight shaft could be done in the usual way. Removal from the lathe can be effected in a very few minutes, and no change is required in the machine for the application of the device other than removing the tool post. It is claimed that it will do this work very much quicker than any other which has yet been designed.

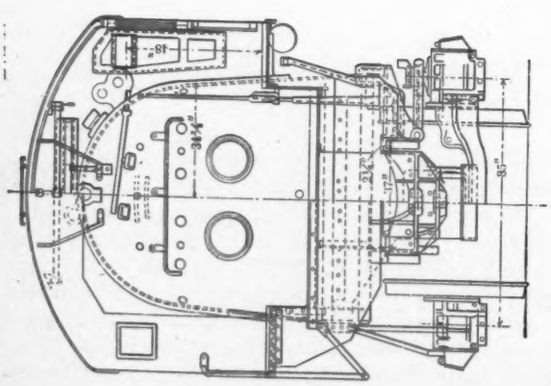
was not overlooked that a wider or narrower ring might be required and this can be secured by separate space or filling blocks, the location of which will be readily apparent from the print.

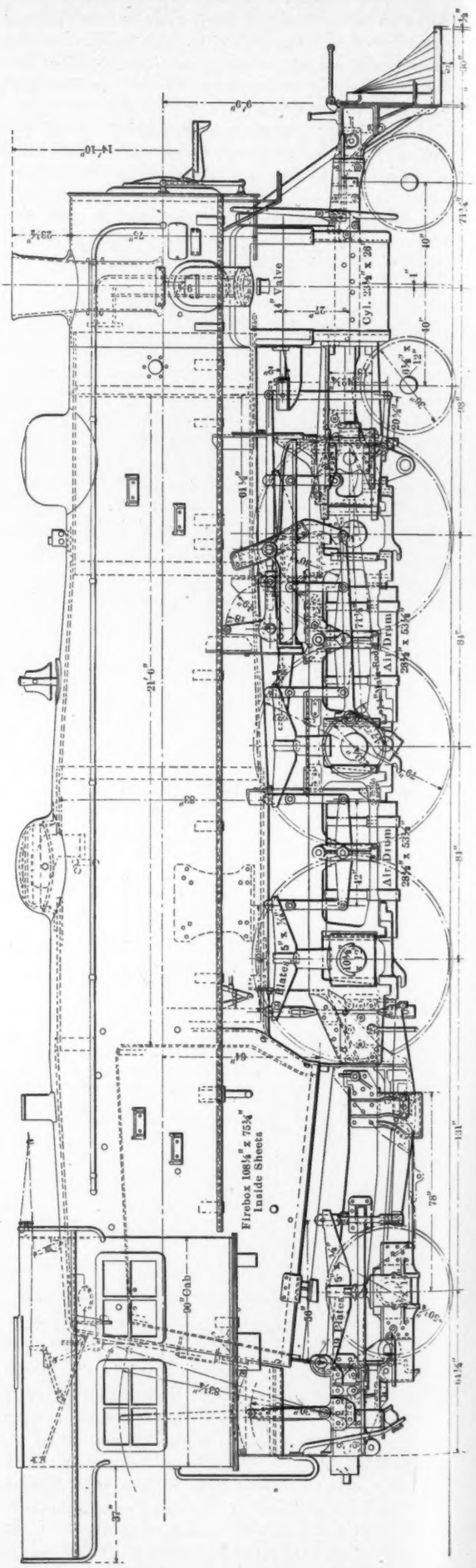
A FLUX FOR USE IN BRAZING CAST IRON can be made by mixing 1 lb. of boric acid, 4 oz. of pulverized chlorate of potash, and 3 oz. of carbonate of iron. To make a good brazed joint, the metal should be carefully cleaned and the pieces heated to a bright red before applying the flux.









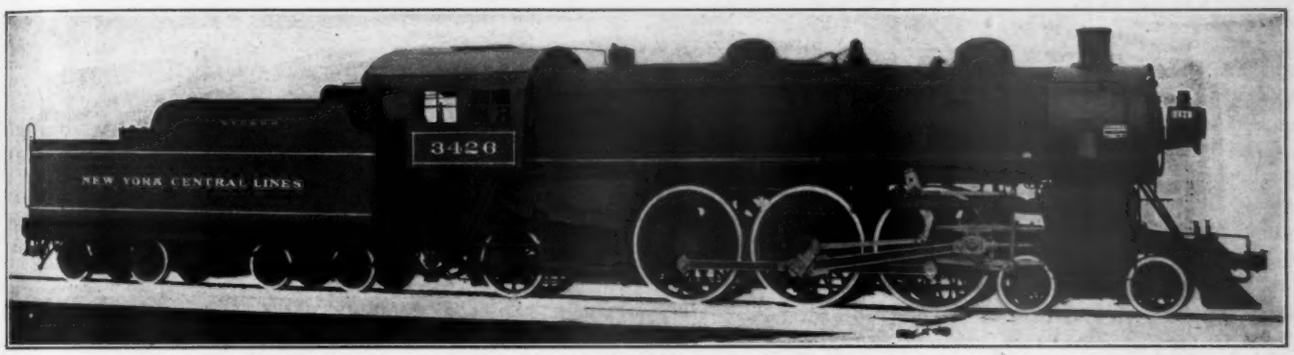


VERY POWERFUL PASSENGER LOCOMOTIVES WITH SCHMIDT SUPERHEATERS—NEW YORK CENTRAL LINES.

Pacific Type Passenger Locomotive With Schmidt Superheater

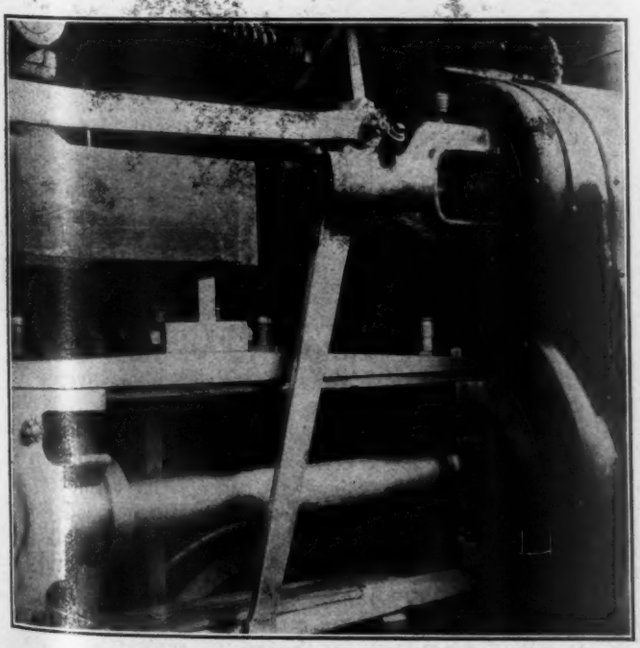
NEW YORK CENTRAL LINES.

Passenger trains, weighing over 800 tons, which must be handled at high speeds, are becoming not uncommon on many of the railways. This is particularly true on the New York Central and Pennsylvania Lines, and during winter weather and periods of heavy traffic it is often necessary to double head these trains over certain divisions. Both of these systems have Pacific or Atlantic type locomotives which are able to make schedule time with these heavy trains, but when called upon to make up time or when handicapped by severe weather they have not sufficient reserve power.



HIGH SPEED PACIFIC TYPE LOCOMOTIVE WITH SUPERHEATER—NEW YORK CENTRAL LINES.

On the New York Central Lines the standard heavy passenger engine has been for several years a Pacific type with 22 x 28 in. cylinders, 79 in. wheels and 4,210 sq. ft. of heating surface. These locomotives were fully illustrated and described in this journal on page 365 of the September, 1907, and 164 of the May, 1908, issues. The service with them in the past has been eminently satisfactory in every way and up to a comparatively recent date they had sufficient reserve power for all emergencies. The introduction of steel passenger cars and Pullmans, together with the increased passenger traffic, however, has finally brought the weight of passenger trains to a point where it was desirable to have a more powerful locomotive, and before making the last order of 20 engines of this type a careful study of the situation was made. In connection with the American Locomotive Co. experiments were carried out and it was finally decided that the increased capacity desired could be satisfactorily attained through the medium of superheated steam, therefore the last order was equipped with the latest design of Schmidt fire tube superheaters. Careful tests with a single locomotive equipped in this manner indicate that the superheater increased the boiler capacity sufficiently to allow increasing the diameter of the cylinders to 23½ in. if the stroke was shortened to 26 in. The boiler was thus redesigned and changed so as to give a distance between tube sheets of 21 ft. 6 in. instead of 20 ft., as has been standard, also for the application of the superheater tubes, but was not altered in other respects.



NEW VALVE STEM CROSSHEAD AND GUIDE.

One of the illustrations shows a view of the front end with the superheater and it will be noticed that a special design and arrangement of steam pipes has been employed. It was desired, of course, to obtain the maximum free area under the table plate in the front end and therefore the steam pipes were brought out through the shell at a point just below the center and carried into the top of the valve chamber. This arrangement not only gives a freer and better design of front end, but also greatly improves the cylinder casting and gives the most direct passage from the superheater to the steam chest.

Outside of these changes in the boiler and front end, the only other noticeable alteration from the standard engine is found in the valve gear cross head and guide, wherein the guide is secured to the valve chamber head only instead of between the guide yoke and valve chamber head, insuring the absolute alignment of the valve stem and greatly simplifying the construction. This arrangement is somewhat like that standard on the Canadian Pacific Railway.* In other respects the valve gear is the same as was previously used.

The trailer truck has also been redesigned to use a single bar frame with outside bearings in place of the previous double bar frame construction. This change has lightened the frame considerably and made it more easy for repairs and inspection.

A heavy pressed steel bumper plate in U section has for the first time in American practice been used on these locomotives in place of the conventional steel casting or wooden bumper beam.

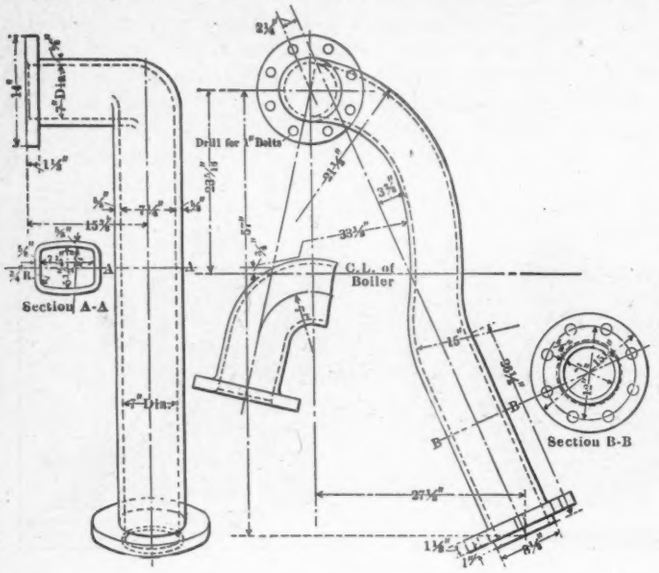
In the following table will be found the general dimensions of these locomotives as compared with the previous design:

GENERAL DATA.

	Previous design	Latest design
Fuel	Bit. Coal	Bit. Coal
Tractive effort	29,200 lbs.	30,900 lbs.

* AMERICAN ENGINEER, Jan., 1908, page 16.

Weight in working order	266,000 lbs.	269,000 lbs.
Weight on drivers	170,500 lbs.	171,500 lbs.
Wt. of engine and tender in working order	431,000 lbs.	424,000 lbs.
Wheel base, driving	14 ft.	14 ft.
Wheel base, total	36 ft. 6 in.	36 ft. 6 in.
Wheel base, engine and tender	67 ft. 11 in.	67 ft. 11 in.
RATIOS.		
Weight on drivers ÷ tractive effort	5.84	5.55
Total weight ÷ tractive effort	9.11	8.71
Tractive effort × diam. drivers ÷ heating surface	550.00	534.00*
Total heating surface ÷ grate area	74.50	81.00*
Firebox heating surface ÷ total heating surface, %	5.35	5.07*
Weight on drivers ÷ total heating surface	40.70	37.50*



STEAM PIPES ON SUPERHEATER LOCOMOTIVE.

Total weight ÷ total heating surface	63.10	59.00*
Volume both cylinders, cu. ft.	12.32	13.10
Total heating surface ÷ vol. cylinders	341.00	348.00*
Grate area ÷ vol. cylinders	4.58	4.32
CYLINDERS.		
Kind	Simple	Simple
Diameter and stroke	22 x 28	23½ x 26
VALVES.		
Kind	Piston	Piston
Diameter	14 in.	14 in.
Greatest travel	6 in.	7 in.
Outside lap	1 in.	1⅛ in.
Inside clearance	⅛ in.	⅛ in.
Lead in full gear	¼ in.	¼ in.
WHEELS.		
Driving, diameter over tires	79 in.	79 in.
Driving, thickness of tires	3½ in.	3½ in.
Driving journals, main, diam. and length	10½ x 12 in.	10½ x 12 in.
Engine truck wheels, diameter	36 in.	36 in.
Engine truck, journals	6½ x 12 in.	6½ x 12 in.
Trailing truck wheels, diameter	50¼ in.	50¼ in.
Trailing truck, journals	8 x 14 in.	8 x 14 in.
BOILER.		
Style	Conical	Conical
Working pressure	200 lbs.	200 lbs.
Outside diameter of first ring	72 in.	72 in.
Firebox, width and length	75¼ x 108⅛ in.	75¼ x 108⅛ in.
Firebox plates, thickness	⅜ & ½ in.	⅜ & ½ in.
Firebox, water space	4½ in.	4½ in.
Tubes, number and outside diameter	382—2 in.	175—2¼ in. & 32—5 in.
Tubes, length	20 ft.	21 ft. 6 in.
Heating surface, tubes	3,981.6 sq. ft.	3,192.9 sq. ft.
Heating surface, firebox	228.3 sq. ft.	231.2 sq. ft.
Heating surface total	4,209.9	3,424.1 sq. ft.
Superheater heating surface		755 sq. ft.
Grate area	56.5 sq. ft.	56.5 sq. ft.
Smokestack, diameter	20 in.	19½ in.
Smokestack, height above rail	14 ft. 7⅞ in.	14 ft. 10 in.
TENDER.		
Frame	13 in. chan.	13 in. chan.
Wheels, diameter	36 in.	36 in.
Journals, diameter and length	5½ x 10 in.	5½ x 10 in.
Water capacity	8,000 gals.	7,500 gals.
Coal capacity	14 tons	12 tons

* Heating surface = evaporating surface + 1.5 times superheating surface.

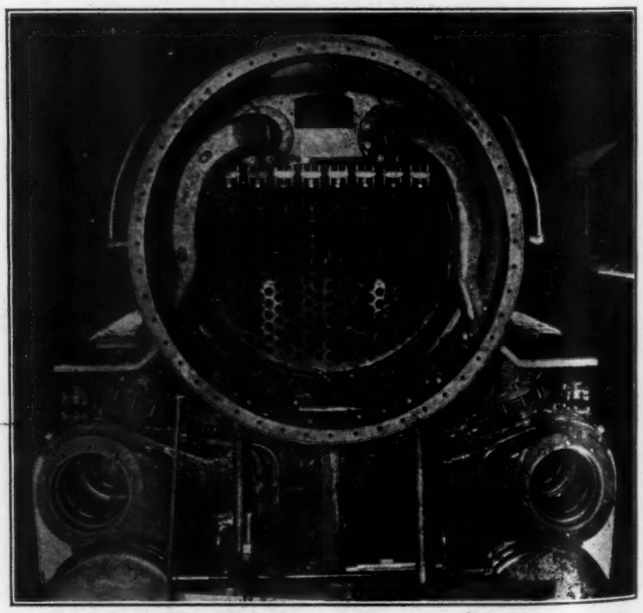
IT IS REPORTED THAT THE RUSSIAN GOVERNMENT contemplates the improvement of the existing Siberian Railway and creating duplicate approaches both in European Russia and the Far East. When these works are completed, in 1915, the imperial treasury will have expended on the Siberian Railway somewhat over $1,000,000,000, which includes both cost of construction and loss on exploitation. In exchange for this Russia will have a complete double-track system from the Urals to the Pacific, with double approaches, of a total length of 6,844 miles.

THREE YEARS TESTS OF FEED WATER HEATING BY THE TREVITHICK SYSTEM

Some surprising results in increased economy are indicated by the returns from the elaborate tests of feed water heating on locomotives just completed on the Egyptian State Railways. These tests began in March, 1907, and have been continued in connection with many types of locomotives and under all conditions of service. The final summaries are of extreme interest as the economy is shown to be upwards of 20 per cent. in connection with engines equipped with the feed water appliance over those not so equipped, and the tests have served the purpose of demonstrating as facts many points formerly regarded as largely theoretical.

Attention was first attracted to this matter toward the end of 1907, when F. H. Trevithick, locomotive, car and wagon superintendent of the Egyptian State Railways, applied a feed water heater of his own design to an engine of those roads.* In this instance, which has been followed throughout all the subsequent tests with few modifications the feed water is drawn from the tender and forced into the boiler by means of a horizontal duplex pump located on the right side just ahead of the cab. This pump takes steam at boiler pressure and delivers its exhaust into the first section of the feed water heater which is located on the suction side of the pump. This first heater is vertical and contains nineteen ⅝ in. tubes, which are connected to headers at each end, the upper header being connected to the exhaust pipe from the pump, and the lower header having an opening to the atmosphere. The feed water circulates around the outside of the tubes.

On leaving the pump the water traverses in succession two other heaters, one on either side of the smoke box. The one on the right is divided into two compartments by a partition, so that the water traverses twice the length of the heater in passing through. It then goes to the left heater, in which there is no dividing partition. These two heaters are heated by part of



VIEW SHOWING SCHMIDT SUPERHEATER AND ARRANGEMENT OF STEAM PIPES—NEW YORK CENTRAL 4-6-2 LOCOMOTIVES.

the exhaust steam from the cylinders. From these the water passes to the larger heater in the front end, which consists of an annular chamber containing 265 tubes 1 in. diameter and 18 in. long, arranged in three concentric rings and heated by the exhaust gases passing through the tubes. The total section of the heater tubes, which is but little larger than the section of the smokestack, is entirely utilized, and their position in reference to the fire tubes assures a perfect separation of the escape

* See AMERICAN ENGINEER, November, 1907, page 456

gases to the interior of them all. From this heater the water passes to the boiler through the usual check valves.

As has been mentioned the tests were made in all services, fast express, light passenger, freight and switching, and during the various applications of the heater to various types some minor changes were made in the relative proportion of the parts, but the basic principle was not affected, and the description given above will serve to illustrate the system.

Taking first the records of engine 711 for the years 1907, 1908 and 1909. This engine was one of a class of thirty, and it shows up very well when compared with the rest of its class. The figures in Table 1 below are taken from the ordinary registers, and therefore show all coal booked to the engines. The mileage given is train mileage only, and the weight of train is calculated on the commonly used service method abroad of rating a six-wheel passenger coach as one unit of 15 tons, and a coach with two four-wheel trucks as two units, or 30 tons, the figures agreeing very closely with the average for the rolling stock used on the train service in question on the Egyptian State Railways. During the period covered by these records, engine 711 was taken into the shop, and for purposes of certain experimental work, had her heaters removed, subsequently working without them for some time. The records for this engine thus afford an independent and unintentional check. Table I gives the averages from the coal records for the whole class of 30 engines, and also for engine 711 for the period during which it was at work without heaters.

TABLE I.—COMPARISON OF ENGINE NO. 711 WITHOUT AND WITH HEATERS, AND WITH TWENTY-NINE SISTER ENGINES WITHOUT HEATERS, UNDER ORDINARY RUNNING CONDITIONS.

	Engine No. 711 Without Heaters.	Engine No. 711 With Heaters.	29 Sister-Engines Without Heaters.
Average miles per train	138	127.8	136
Average pounds of coal per train	5,660	4,595	5,497
Average pounds of coal per mile	41	35.9	40.2
Average load behind tender, tons	249.6	281.6	231
Average pounds of coal per ton mile	0.1643	0.1276	0.1749
Difference in favor of engine No. 711 with heaters, on coal per ton mile		0.036 lb. = 22%	0.0473 lb. = 27%

The high figure of 27 per cent. is probably due in part to the fact that at one time and another engine 711 has been engaged in special trials, and the coal booked to it, therefore, has at times been more carefully checked than is usual under ordinary running conditions.

The record of engine 677, an inside cylinder 4-4-2 locomotive, is also of much interest. This engine has cylinders 18 in. by 26 in., and driving wheels 6 ft. 3 in. in diameter. The boiler is fitted with a Belpaire box, and contains 184 2-in. flues, 15 ft. 11¼ in. between flue sheets, giving 1535.5 sq. ft. heating surface. The firebox provides 140.25 sq. ft., making a total of 1675.75 sq. ft. The grate area is 24 sq. ft. The total weight of the engine in working order is 63 tons, of which 35 tons are on the driving wheels. The heaters of No. 677 are similar to those of No. 711, except that the smokebox heater is of rather larger heating surface capacity, having 258 sq. ft. heating surface and a capacity of 70 gallons.

During two months in 1907 this engine ran without its smokebox heater, as it required some alterations when delivered to the railway, before it could be brought into use. In February, 1908, the heaters were not used, and the effect of the flue gases upon it, when out of service, was watched. Again, in 1909, on the smokebox heater needing re-tubing, the arrangement was removed. The results taken from the ordinary registers are as indicated in Table II, for the period March, 1907, to December, 1909.

TABLE II.—WORKING OF ENGINE NO. 677 WITH AND WITHOUT FEED WATER HEATERS.

	With Heaters.	Without Heaters.
Average miles per train	135.7	135.9
Average pounds of coal per train	5,024	6,138
Average pounds of coal per mile	37	45.1
Average weight behind tender, tons	280	278.4
Average pounds of coal per ton mile	0.1322	0.1622
Difference in favor of heaters on coal per ton mile	0.0300 = 18%	

From the records for this engine another set of figures has been abstracted, showing the comparison for six months' working only, with and without heaters, over certain periods for which weather conditions were approximately similar. These figures differ somewhat from those given in the above table, the loading during the periods in question showing greater difference than above. For these periods for which the results are really more strictly comparable, the coal per ton-mile with the heaters in use shows economy amounting to 20.5 per cent. All of the figures in the tables, it will be noted, are large and the effect on the coal bill well worth considering.

EXTENSION OF TIME AND MODIFICATION OF SAFETY APPLIANCE RULES

After conference with representatives of the railways and of the employees' brotherhoods, a form of order has been drawn up by the Interstate Commerce Commission providing that the time for complying with the law respecting brakes, ladder clearance, and certain other features of freight car safetly appliances, should be extended for five years from July 1, 1911; the time to make similar changes on passenger cars for three years from the same date; on road locomotives two years, and on switching locomotives one year. The bill now before Congress, appropriating money for the expenses of the Interstate Commerce Commission for the next fiscal year, contains a clause empowering the Commission to postpone the date of compliance with this law, not only as regards old cars, but also as regards cars put in service up to July 1, 1911. As the law was passed originally, the Commission could not extend the time limit except in relation to cars which were in service April 14, 1910.

At a final meeting before the Commission in Feb., at which were present five representatives from the committee of the railways, five of the committee of railway employees, and five for the special committee of the agents of the Commission, the following stipulations and modifications in the new rules were agreed upon:

(a) That carriers will not be required to change the brakes from right to left side on steel or steel underframe cars with platform end sills, or to change the end ladders on such cars, except when such appliances are renewed, at which time they must be made to comply with the prescribed standards.

(b) That carriers will be granted an extension of five years' time from July 1, 1911, to change the location of brakes on all other cars to comply with the prescribed standards.

(c) That carriers will be granted an extension of five years' time from July 1, 1911, to comply with the prescribed standards on other brake specifications on all cars.

(d) That carriers will not be required to make changes to secure additonal end-ladder clearance on cars that have ten or more inches end-ladder clearance, within thirty inches of side of car, until car is shopped for work amounting to practically the rebuilding of the body of the car, at which time they must be made to comply with the prescribed standards.

(e) That carriers will be granted an extension of five years' time from July 1, 1911, to change cars having less than ten inches end-ladder clearance, within 30 inches of side of car, to comply with the prescribed standards.

(f) That carriers will be granted an extension of five years' time from July 1, 1911, to change and apply all other appliances on freight train cars to comply with the prescribed standards, except that when a car is shopped for work amounting to practically rebuilding the body of the car, it must then be equipped with the prescribed standards in respect to handholds, running boards, ladders, sillsteps, and brake staffs. Provided, that the extension of time herein granted is not to be construed to relieve a carrier from complying with the provisions of Section 4 of the act of March 2, 1893, as amended April 1, 1896, and March 2, 1903.

(g) That carriers will not be required to change the location of handlholds (except end-handholds under endsills, ladders, sillsteps, brake wheels and brake staffs), on freight train cars the appliances are within three inches of the required location, ex-

cept that when cars undergo regular repairs they must then be made to comply with the required standards.

(h) That carriers will be granted an extension of three years' time from July 1, 1911, to change passenger train cars to comply with the prescribed standards.

(i) That carriers will be granted an extension of one year's time from july 1, 1911, to change switching locomotives to comply with the prescribed standards.

(j) That carriers will be granted an extension of two years' time from July 1, 1911, to change all other locomotives to comply with the prescribed standards.

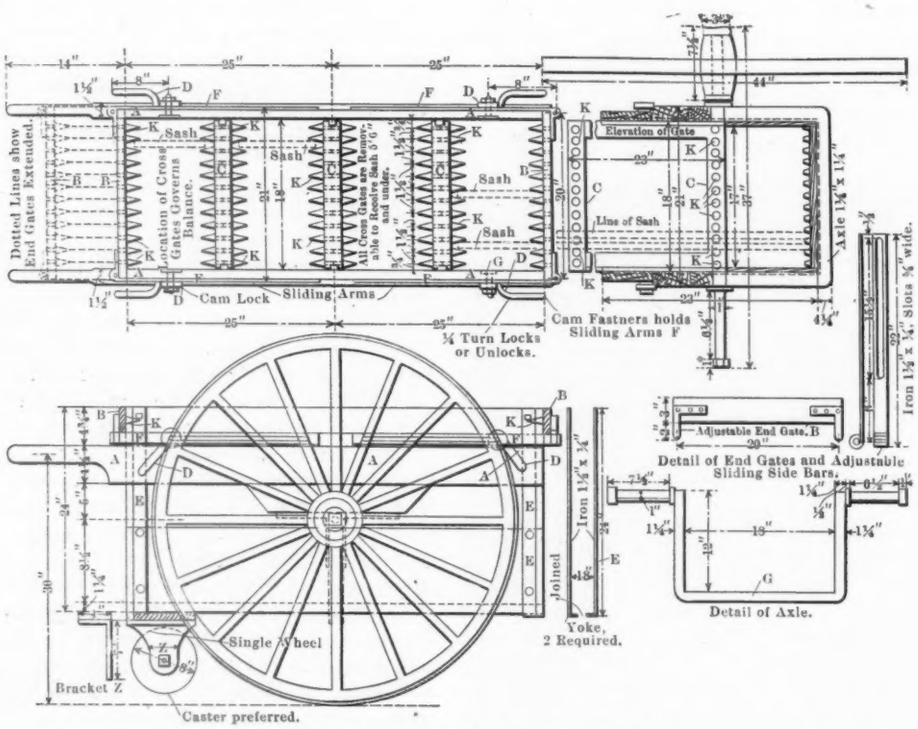
It will, of course, be understood that all these extensions of time apply to equipment that is already built and in use, and not to new equipment.

HAND TRUCK FOR CAR SASH

A very handy truck for distributing newly varnished car window sash, of which the working drawing is reproduced herewith, is being used to much advantage in the Readville shops of the New York, New Haven and Hartford Railroad. It permits the loading of sash so that they will not come in contact with one another or become soiled and does away with quite a large gang of men who were obliged to carry the sash singly previous to its advent. In a large shop where from four to five hundred are being distributed every day this labor-saving becomes no insignificant item, as in many cases cars to which the sash belongs are located a long distance from the varnish room.

The general arrangement of the truck is clearly indicated in the drawing. As shown, it consists of two sides and a bottom, the sides being connected by the cross framing and the sliding end gates. One or all of the cross frames can be entirely removed when required, thus permitting sash five feet or more in width to be carried by adjusting the side gates and sliding ends. All of the cross gates or frames (C) and the end gates (B) are provided with cone-shaped pins, or separators, shown at (K), which hold the sash from striking one another while in the truck. The sliding ends (E) are held and carried by the arms (F), which slide in guides or grooves on the sides of the truck, and are fastened at any point by the handle cam nuts (D) which lock or unlock with a one-quarter turn.

One-half the sash equipment for a long car can be loaded on this truck and moved to any point of the shop by a boy. One of them has been in service for two years and two others have since been added. The cost of production is very small and it cannot fail to prove a valuable addition to any car shop.


Dotted Lines show End Gates Extended.
Location of Cross Gates Governs Balance.
All Cross Gates are Reversable to Receive Sash 5'6" and under.
Sash
Cam Lock
Sliding Arms
¼ Turn Locks or Unlocks.
Cam Fastners holds Sliding Arms F
Elevation of Gate
Line of Sash
Axle 1¼" x 1¼"
Iron 1½" x ¾", Slots ¾" wide.
Adjustable End Gate, B
Detail of End Gates and Adjustable Sliding Side Bars.
Detail of Axle.
Iron 1½" x ¾"
Joined
Yoke, 2 Required.
Single Wheel
Bracket Z
Caster preferred.

DETAILS OF TRUCK FOR CAR WINDOW SASH.

NINE MORE ELECTRIC LOCOMOTIVES, aggregating about 40,000 horsepower, have been ordered by the Pennsylvania Railroad from the Westinghouse Electric and Manufacturing Company. The new locomotives will be of the same type as those which are now being operated in the Manhattan Terminal, New York City, and will supplement the twenty-four already in use. The Westinghouse Electric and Manufacturing Company has contracted to have the new locomotives completed by July 1st, 1911. The cabs, frames, running gear and mechanical parts will be built by the Pennsylvania Railroad at their Juniata shops. The air brakes will be supplied by the Westinghoue Air Brake Company. The electrical equipments will be built and the complete locomotives assembled at the East Pittsburg works of the Westinghouse Electric and Manufacturing Company.

NEW TERMINAL FOR CUBAN RAILROADS.—The new passenger terminal in Havana, Cuba, which is in the course of erection for the Havana Terminal Company, will be one of the finest and most up-to-date structures in Cuba. It is situated on what is known as the Arsenal site near the harbor, and will be built in connection with wharves, warehouses, and all the other necessary terminal improvements. The building will be used by the United Railways of Havana, the Havana Central, and the Marianao Railroad, thus serving as the union passenger terminal for the city of Havana. As tourists' traveling is becoming more important every year, the station has been designed to take care of this need, and has a capacity which will suffice to satisfy all requirements for many years to come.

LOCOMOTIVES BURN 100 MILLION TONS OF COAL a year, or one fifth of the total amount mined annually in the United States

Road Test of 2-6-6-2 Type Locomotive

CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

During the months of December and January last the Chicago, Milwaukee & St. Paul Ry. received 25 Mallet compound locomotives built by the Schenectady works of the American Locomotive Co.* These locomotives are of the 2-6-6-2 type and have a 83¾ in. boiler with 439 2¼ in. tubes 24 ft. in length, and a combustion chamber 78 in. in length. This gives a heating surface in the tubes of 6,182 sq. ft. and a total heating surface of 6,554.6 sq. ft., the ratio being 90.5 sq. ft. of heating surface to 1 sq. ft. of grate area. Other general dimensions and ratios are given in the following table:

GENERAL DATA.

Fuel	Bit. Coal
Maximum tractive effort	75,000 lbs.
Weight in working order	390,000 lbs.
Weight on drivers	323,500 lbs.
Weight of engine and tender in working order	555,700 lbs.
Wheel base, driving	30 ft. 6 in.
Wheel base, total	48 ft.

RATIOS.

Weight on drivers ÷ tractive effort	4.30
Total weight ÷ tractive effort	5.20
Tractive effort × diam. drivers ÷ heating surface	653.00
Firebox heating surface ÷ total heating surface, per cent	5.69
Weight on drivers ÷ total heating surface	49.30
Total weight ÷ total heating surface	59.50
Volume equivalent simple cylinders, cu. ft	22.80
Total heating surface ÷ vol. cylinders	288.00
Grate area ÷ vol. cylinders	3.18

CYLINDERS.

Kind	Mellin Compound
Diameter	28½ & 37 in.
Stroke	30 in.

VALVES.

Kind H. P.	Piston
Kind L. P.	Slide
Greatest travel	6 in.
Outside lap H. P.	1 in.
Outside lap L. P.	⅞ in.
Inside clearance	5/16 in.
Lead	3/16 in.

WHEELS.

Driving, diameter over tires	57 in.
Driving, trickness of tires	3½ in.
Driving journals, diameter and length	10 x 13 in.

BOILER.

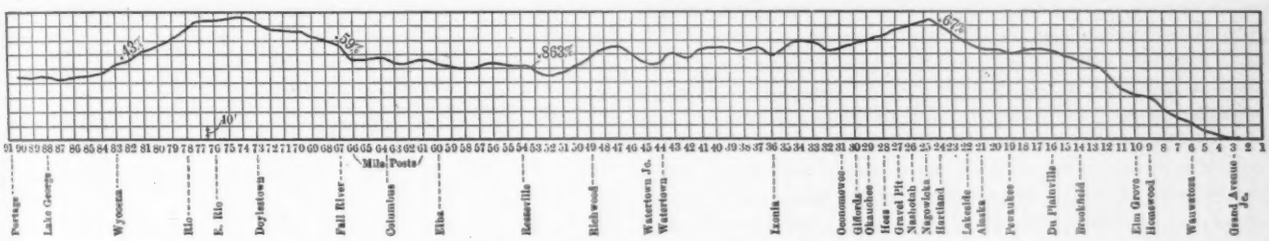
Style	Conical
Working pressure	200 lbs.
Outside diameter of first ring	83¾ in.
Firebox, length and width	108 1/116 x 96¼ in.
Firebox plates, thickness	⅜ & ½ in.
Firebox, water space	F. 5 in., S. & B. 4½ in.
Grate area	72.3 sq. ft.

While these engines were designed for pusher service on the Chicago, Milwaukee & Puget Sound Ry., where the mountain grades range from 1 per cent. to 2.74 per cent., 14 of them are still working in the Milwaukee district, some in regular train service on the Chicago, Milwaukee & La Crosse Divisions and some in transfer and hump yard switching service.

Recently one of these engines, No. 5000, was given a complete road test, with maximum tonnage, from Milwaukee to Portage and return. The distance between these points is 91 miles and is over a division with ruling grades of one-half of one per cent., except about 1½ miles with a grade of .67 per cent. There is one short velocity grade, about 1,000 ft., of one per cent. The profile of the division is shown in the accompanying illustration.

* For fully illustrated description, see page 90, March issue, AMERICAN ENGINEER.

Standard methods for locomotive testing were generally followed and the greatest care was taken to secure accurate and reliable data. The coal used was carefully weighed as it was put on to the tender and two observers checked the results. The fuel for firing up in the enginehouse and for taking the engine to the yards and the amount used after the engine left the train, was taken from a supply in sacks placed on the rear of the tender. The surplus coal at the end of the run was carefully weighed off and proper credit given. Water delivered to the boiler was measured by metering it through three 3 in. Worthington hot water meters, which had been carefully calibrated and the loss from the injector overflow was caught and weighed. The draft in the smokebox and firebox were measured by U tube manometers containing water. The temperature readings for smokebox gases were taken through the medium of the Hookings thermo-electric couple pyrometer. The dynamometer car used was a new one built at the Milwaukee shops and is of the spring type, with a capacity up to 110,000 lbs. The record of the dynamometer contained the usual speed, reverse levers and throttle position, etc.



PROFILE OF DIVISION ON WHICH TEST WAS MADE.

The first run was made on January 23 from Milwaukee to Portage, the train behind the tender consisting of 55 loaded cars, dynamometer car and caboose, making 2,555 tons. On the following day the return trip was made with a train consisting of 43 loads, 79 empties, dynamometer car and caboose, giving a total tonnage of 3,050 as far as Watertown Junction; at this point the tonnage was cut down to 36 loads, 79 empties, dynamometer car and caboose, giving a tonnage of 2,775.

The performance of the locomotive, as indicated by the tests, was most satisfactory. It was shown beyond doubt that the boiler would furnish steam for the maximum horsepower required by the locomotive, which the indicator cards showed reached a maximum of 1,753 on a ½ per cent. grade.

In the following table are given some of the general average results of the tests:

Run	Milwaukee to Portage	Portage to Milwaukee
Distance	91 miles	91 miles
Date	Jan. 23	Jan. 24
Temperature	35°	45°
Time on road	7 hrs. 12 min.	6 hrs. 37 min.
Running time	5 hrs. 23 min.	5 hrs. 41 min.
Speed, average	16.7 m. p. h.	16 m. p. h.
Tonnage	2555 tons	3050-2775
Average steam pressure	197.3 lbs.	198 lbs.
Vacuum in front end	2.96 in. water	2.97 in. water
Firebox vacuum	1.48 in. water	1.98 in. water
Temperature front end	509° F.	511° F.
Temperature feed water	44.6° F.	41.6° F.
Coal fired	25,210 lbs.	28500 lbs.
Water delivered to boiler	203,258 lbs.	222,375 lbs.
Lbs. water per lb. coal	8.07 lbs.	7.8 lbs.
Water evaporated from and at 212° per lb. coal	9.9 lbs.	9.6 lbs.
Ton miles	229,950	265,450
Coal per 100 ton miles	10.96 lbs.	10.78 lbs.
Water per 100 ton miles	88.39 lbs.	83.77 lbs.
Water evaporated per sq. ft. heating surface per hour (running time)	5.74 lbs.	5.96 lbs.
Coal burned per sq. ft. grate area per hour (running time)	64.6 lbs.	69.1 lbs.

On the first day's run the speed varied between 10 and 35 miles per hour, averaging 16.7 miles per hour. On the return trip speeds of from 10 to 30 miles were maintained as far as

Watertown Junction, and from 12 to 29 miles per hour from there to Milwaukee. The maximum draw bar pull registered was 100,000 lbs., starting the train out from the water tank at Columbus on the second day's test. The engine at this time was of course working simple. A draw bar pull of 95,000 lbs. was developed for a distance of 100 ft. at another start and 93,500 at another time. The engine only required about 100 ft. simple operation before being able to handle the train in compound. A draw bar pull of 76,500 lbs. working compound was the maximum registered.

The water rate from the indicator cards showed a consumption of 23.11 lbs. per indicated horsepower hour, the cut-off being from 65 to 75 per cent. It is stated by J. F. DeVoy, assistant superintendent of motive power, under whose direction the tests were carried out, that the locomotive showed an economy over simple engines in the same service of about 21 per cent. in regard to fuel and water. The locomotive, however, was in first-class conditon and it is probable that a fuel economy of from 15 to 20 per cent. can be expected on an average.

Heating Test of Driving Tires

AN INTERESTING RESEARCH INTO THIS GENERAL SUBJECT RECENTLY COMPLETED ON THE CHICAGO AND NORTHWESTERN RAILROAD BRINGS TO LIGHT SOME SURPRISING DATA IN REGARD TO THE GREAT LOSS WHICH ORDINARILY ATTENDS THE OPERATION OF TIRE SETTING.

V. T. KROPIDLOWSKI.

On the road where the writer is employed he recently conducted some very interesting tests in connection with the removal from the wheel centers of locomotive driving tires, and while there was nothing unusual in regard to the process employed, some exceedingly valuable data has been gathered on the operation from an economical standpoint. In one test the tires removed were 56 in. inside diameter and 1¾ in. thick. The fuel used was gasoline, which was atomized in a tank arranged in accordance with the outline drawing shown in Fig. 1. The two tires were heated simultaneously, and the time required for removal was 12 minutes in one instance, and 16 minutes in the other. The amount of gasoline consumed was 4.42 gallons.

The tires were of course light, in comparison with new ones, and the wheels being from under the engine, no obstacle was afforded to driving them off, hence not so thorough a heating was required than would be the case were the wheels in their proper position. In this latter instance the heating must necessarily be such to allow of their being pulled off the centers by a tire hook. The time required to heat two such tires simultaneously, with a burner for each, is in the neighborhood of 40 minutes. The probable consumption of gasoline during the period may be closely approximated by reference to the figures obtained in the test first mentioned simply by averaging the amount of gasoline used per minute, and multiplying by 40 minutes, the result being 12.6 gallons for the assumed case of 40 minutes.

It impressed the writer that the amount of gasoline used was highly excessive, and induced some reflection on how the heavy loss which ensues in the universal practice of heating tires might be overcome at least in part. To burn one pound of gasoline requires about 3.36 pounds of oxygen, which means that 14.6 pounds of air must be used to obtain this amount of oxygen. The products of combustion are practically 3 pounds of carbon dioxide, 1.35 pounds of steam and 11.25 pounds of nitrogen which was contained in the air. The specific heat of carbon dioxide is 0.217, so to raise the temperature of the three pounds one degree requires 0.651 b.t.u. The specific heat of superheated steam is about 0.5, and to raise the temperature of the 1.35 pounds one degree 0.675 b.t.u. are necessary. Nitrogen has a specific heat of 0.244, therefore to raise the 11.25 pounds one degree in temperature 2.745 b.t.u. will be consumed. This means that 4.07 b.t.u. will be absorbed in raising the product of combustion one degree, provided that none of the heat is lost through radiation.

In burning one pound of gasoline there is liberated about 20,000 heat units; consequently the theoretical temperature of the products of combustion will be $20.000 \div 4.07 = 5{,}000$ degrees, but it is a well-known fact that no such temperature is attained in practice, because much of the heat is lost through radiation. Assuming that the temperature, allowing for the radiation of the heat from the flame, is 4,000 above that of the atmosphere, then there will be four-fifths of the liberated heat available for heating the tires; in other words, about 16,000 heat units. All of this is not, of course, available, because if all the heat were taken out of the flame the latter must cease to exist. Assuming that 100 degrees temperature is sufficient to sustain the ignition after once established, there is then available a net temperature for heating the tires $4000 - 100 = 3900$, and, roughly speaking, 15,600 heat units.

It is positive that the tires had not attained any such temperature, as the melting point of steel is but 2,500 degrees. From the writer's observations the temperature was not more

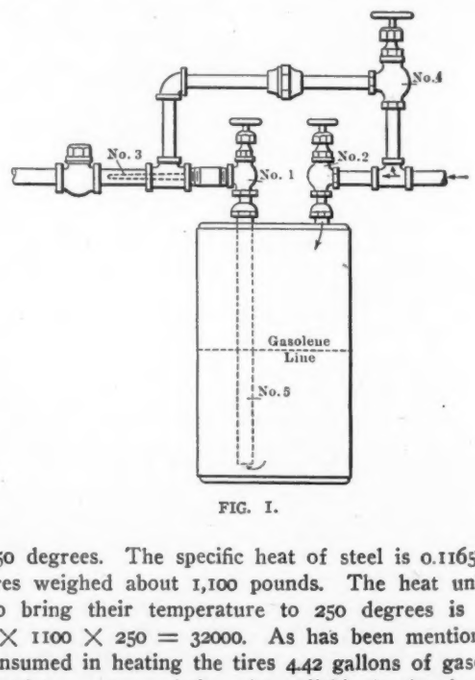


FIG. I.

than 250 degrees. The specific heat of steel is 0.1165, and the two tires weighed about 1,100 pounds. The heat units necessary to bring their temperature to 250 degrees is therefore $0.1165 \times 1100 \times 250 = 32000$. As has been mentioned, there was consumed in heating the tires 4.42 gallons of gasoline, and at 15.600 b.t.u. per pound there is available for heating the tires a net sum of 561,000 b.t.u. This amount of gasoline weighs about 36 pounds, and at this rate there was only available some 6 per cent. of the net heat available for heating the tires. The question then must arise, where did the balance go?

The writer is of the opinion that much of this loss can be satisfactorily accounted for. Referring to Fig. 1, the compressed air enters the tank through globe valve No. 2, expands, and gives up its heat arising therefrom to the walls of the tank, the latter in turn radiating it to the shop atmosphere. In such

a manner refrigeration is, of course, taking place to a small extent. The purely cold liquid is forced by the air pressure above it through pipe No. 5, through needle valve No. 1 and nozzle No. 3 to the burner. On its way to the burner after leaving the nozzle the liquid gasoline is picked up by the gusts of compresed air from the by-pass which comes through valve No. 4, and the gasoline becomes still further refrigerated, as here the compressed air expands from a pressure of about 100 pounds to practically that of the atmosphere, and the absorbtion of heat must be considerable.

During this process the gasoline has not been vaporized, but merely dispersed into globules through the fanning action of the refrigerated air. When this mixture of globules and air

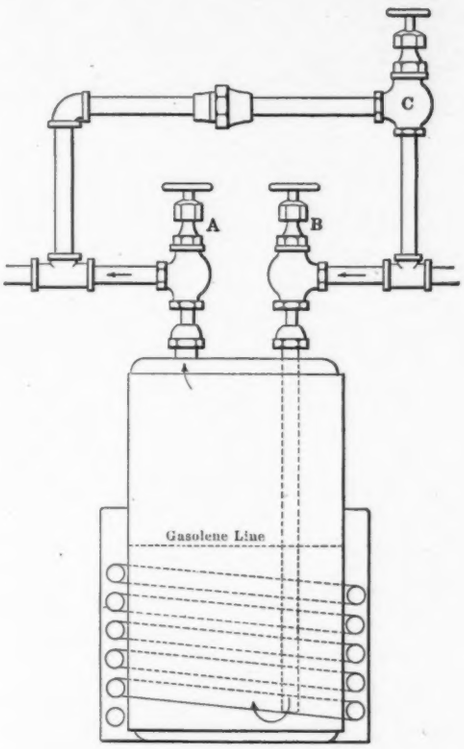


FIG. 2.

reach the burner, the globules which happen to be small enough will ignite, but the larger ones are checked by the walls of the burner to run out on the floor, where part soaks into the wood or earth and the others evaporate or become ignited. This, and the radiation of heat, are the main sources of loss, but the former is by far the greater.

The loss of the liquid gasoline can be overcome entirely by arranging the heating apparatus as shown in Fig. 2. Instead of the compressed air coming in on top of the gasoline it should be *vice versa*, entering through the valve (B) to the pipe, which extends very close to the bottom, and bubbling up through the liquid. The tank should have a coil of pipe and the coil jacketed so that when steam is allowed to circulate in the coil heat will not radiate into the shop atmosphere. Then, as the air would bubble up through the liquid gasoline and excelsior, the former would become broken up into globules, and finally vaporized, on account of a temperature being maintained at which gasoline best vaporizes. There would be no solid globules left to be carried to the burner only to run out of it unconsumed, as has been mentioned. To overcome the loss from radiation is a more complicated question and it must be principally taken care of in the design of the burner; one of such design that the flame will be enclosed and kept always impinging upon the tire surface.

The loss in money per annum to a railroad having, say, 1,500 locomotives, is worthy of serious consideration in the general question of tire heating. The shop with which the writer is connected takes care of about 300 locomotives per year and removes and applies approximately 900 tires. This is but one-fifth of the engines, and consequently the same proportion of tires handled on the entire railroad, which would be in the vicinity of 4,500 tires heated twice, this double treatment bringing the heating up to 9,000 tires. As the statement has been made that but 6 per cent. of the available heat has been realized, then 94 per cent. is accordingly wasted. If 50 per cent. of this loss can be recovered the proposition becomes endowed with much importance. Since it required 4.42 gallons of gasoline to remove the tires under test in an average of 14 minutes each, the portion used was 0.31 gallons. The average time, however, for such removal with the wheels under the engine must be set a minimum of 30 minutes, which would bring the total consumption to 9.3 gallons for heating two tires, or 4.6 gallons per tire.

Forty-five hundred tires heated twice in each year is equivalent to 9,000, which multiplied by 4.6, equals 41,400 gallons of gasoline wasted, which positively could be saved, as it will be recalled that the writer is taking only 50 per cent. of the calculated loss. This means in money, if gasoline can be bought for 13 cents per gallon, no less than $5,382. The writer believes that it would be worth while to delegate a man at a fair salary to devote his entire time to this matter until straightened out. There is no question but that intelligent inquiry and co-operation with the shop forces would bring about a reduction in cost so great as to be surprising.

Stamping Dates on Cross Ties.—The Lehigh Valley Railroad has adopted a plan for recording the age of every new cross tie on the system. This will enable the company to determine, with mathematical accuracy, the relative efficiency of the different woods and the value of the creosote preservation treatment. It is done in this way: First, the dating nails are manufactured with the proper numerals on the heads, indicating the year; for example, "11," meaning the year 1911. Then one of these nails is driven into each new tie as it is laid on the track. Thus in the future the maintenance of way experts will be able, upon the replacement of a tie, to know just how long it has lasted.

The Modern Gear Wheel represents the latest refinements in the application of geometry to mechanics, and the study of the proper curves for tooth profiles has been supplemented by the production of highly organized machine tools for the precise reproduction of these forms in the actual teeth of the wheel. It is often overlooked, however, that, under the demands of modern intensified manufacturing operations, the wear upon such teeth will make such modifications in their form that, unless the material is of the most resistant character, these curves, so carefully studied and so accurately reproduced, will be gone long before the operative life of the wheel is over.

It is Estimated that Oil as Locomotive Fuel is rapidly on the increase. Statistics show that the consumption of fuel oil on the roads in 1909 amounted to 19,939,394 barrels, an increase of about 18 per cent. (3,050,324 barrels) over 1908. Oil as fuel has several good points in its favor over coal; besides being easier to use in the firebox it also does away largely with the smoke nuisance, danger from sparks, etc.

The Ordinance Requiring Railroads within the city limits to adopt electric motive power, came before the city council of Chicago for action on Monday evening, March 6. After heated discussions for and against the ordinance the matter was referred to the council committee on local transportation and a series of public hearings arranged for.

The total length of the running track of the railways of the United Kingdom at the end of 1909 was 39,622 miles, and the total length of sidings was 14,350 miles. At the end of 1908 the length of running track was 39,316 miles.